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MACHINERY

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The Monthly Magazine of Engineering and Production in the Manufacture of Metal Products

TENTH AIRCRAFT PRODUCTION NUMBER

SHOP PRACTICE

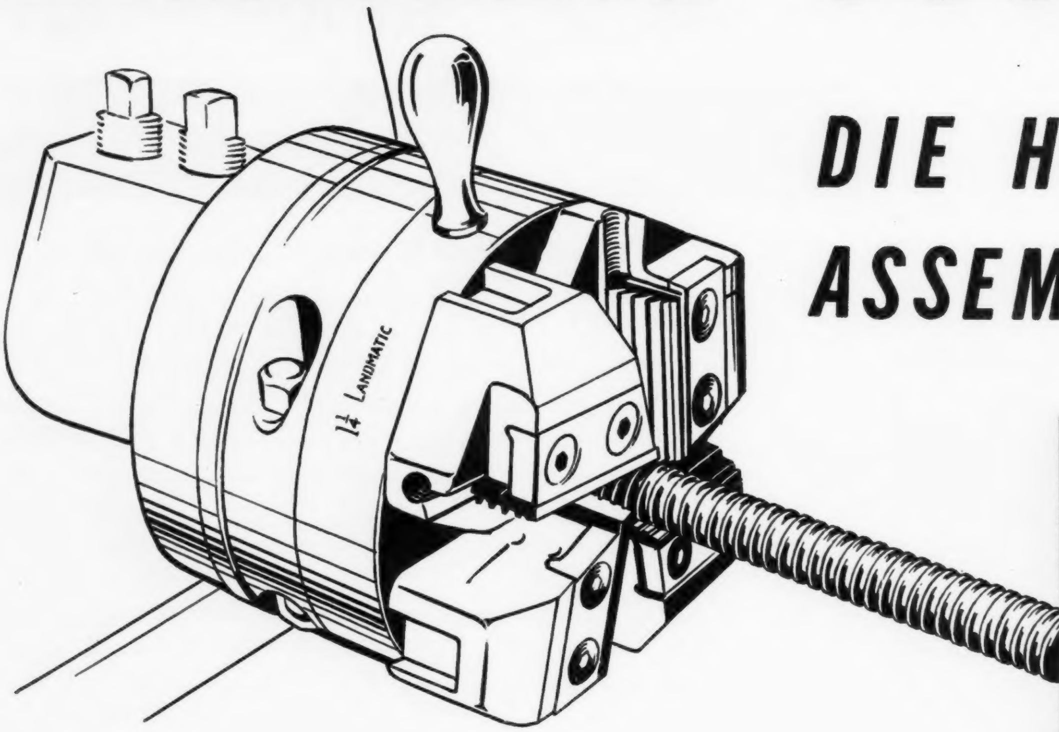
MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS

DEPARTMENTS

THREADING COSTS

DIE HEAD ASSEMBLY



Time Study and Methods Department records of a large aviation equipment company furnish data of still another job where LANDMATIC Heads have effected large savings in machine time and assembly and improvements in product quality.

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MACHINERY

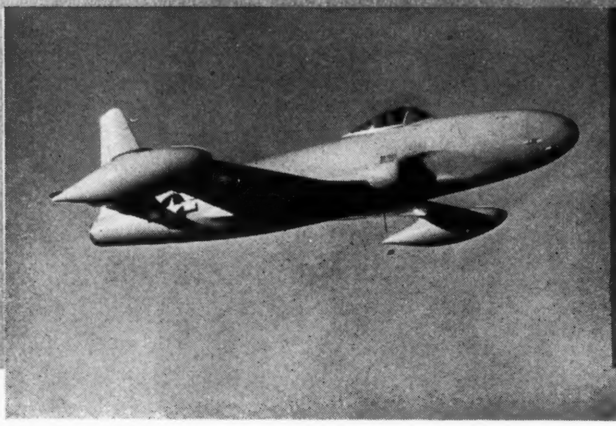
Vol. 55 JULY, 1949 No. 11

NEW AIRCRAFT NEW METHODS

Aircraft developments continue into the realm of fantasy. Rocket planes faster than 3000 miles an hour – ram jet planes that fly at speeds over 1000 miles an hour – huge bombers that circumscribe the world in less than four days. These developments call for manufacturing processes capable of producing aircraft components that will withstand tremendous stresses and high temperatures. Some of the advances made in manufacturing methods to meet today's aircraft requirements are described in this issue — the Tenth Aircraft Production Number of MACHINERY.

Boeing B-47 "Stratojet" Bomber

Heat-Treating Steel Parts for Allison Jet Engines



Lockheed F-80 "Shooting Star" Jet Fighter

By E. P. ZINK
Superintendent of Heat Treating
Allison Division
General Motors Corp.
Indianapolis, Ind.

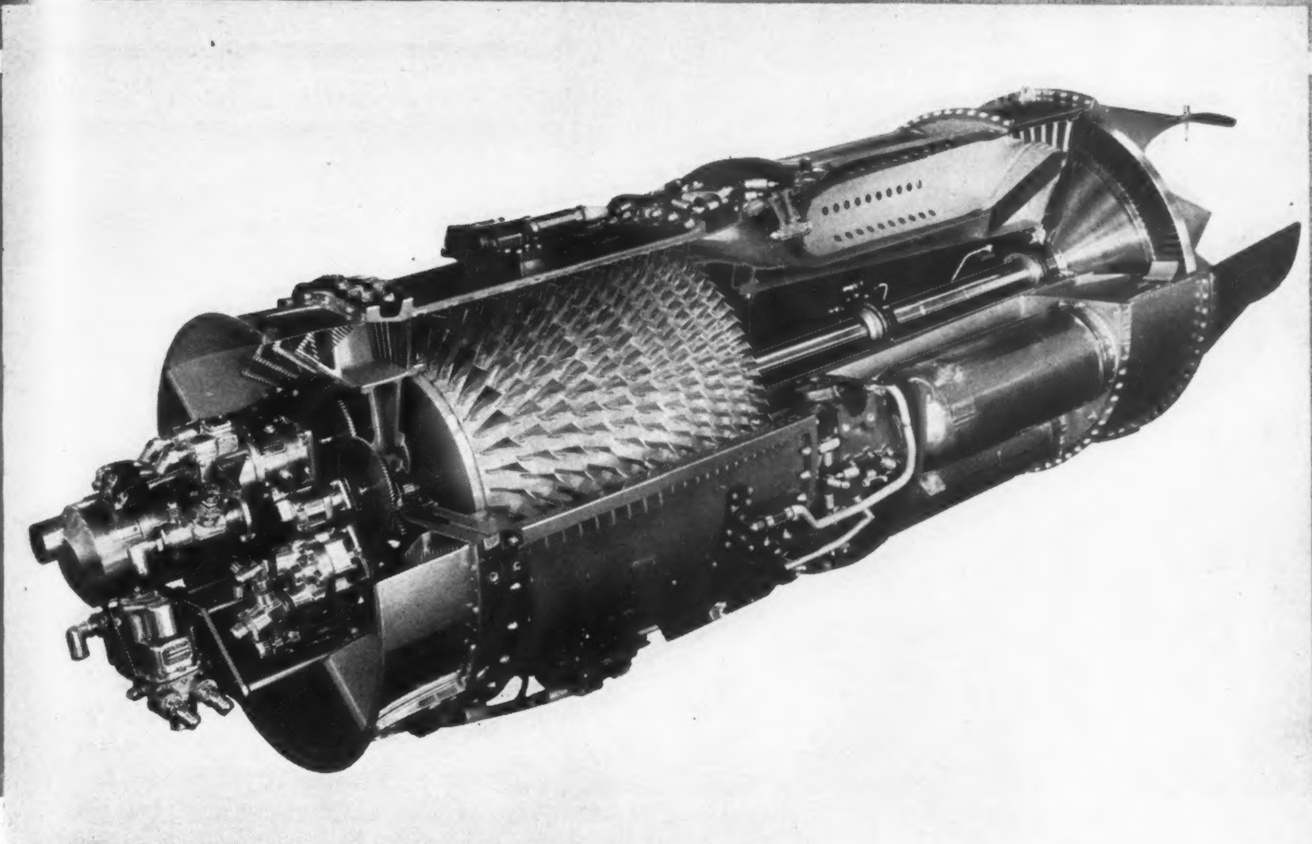
Heat-Treatment of Precision Steel Parts is a Serious Production Problem in the Manufacture of Turbo-Jet Aircraft Engines Because of the High Hardness Necessary and the Dimensional Accuracy that Must be Maintained. Techniques Developed at General Motors' Allison Division for Hardening, Carburizing, and Nitriding Such Parts are Described Here

PRODUCTION problems have arisen in the manufacture of turbo-jet engines because of the rapid rate at which such engines were developed and the limited experience available. Heat-treatment of the precision steel parts required in these engines has been one of the major problems because of the high hardness necessary and the dimensional accuracy specified. The high temperatures reached in the engine, and the large temperature differentials in the parts themselves, have introduced serious heat distortion problems.

Ultimate physical properties, maximum structural uniformity, and minimum changes in the dimensonal accuracy of heat-treated jet-engine parts have been obtained at the Allison Division of General Motors Corporation by close control of temperatures of the furnaces and quenching oil, extensive use of properly designed quenching dies, operator skill, and deviations from conventional heat-treating practices to suit the requirements. Many rings and gears having large diameters and thin walls or webs are held within close dimensional tolerances during heat-treatment. These heat-treating practices have resulted in extending the service life of some of the engine parts.

Methods of Accurately Controlling Furnace Temperatures

Of major importance in the accurate control of furnace temperatures is the use of high-quality thermo-couples, connectors, lead wires, and control instruments, and the correct location of the thermo-couple in the furnace. Because most standard thermo-couples are only accurate to within $\pm$ 10 degrees, the Allison Division makes



all of its own thermo-couples. By using a special electrically heated testing furnace; a platinum, platinum-rhodium thermo-couple calibrated by the National Bureau of Standards; and a precision potentiometer type of temperature indicator, the thermo-couples produced can be tested within 0.2 degree F.

High-quality wire is purchased and carefully inspected before being made into thermo-couples. It is desirable, for the most accurate results, to use the smallest diameter wire possible, taking into consideration, of course, the length of life that will be obtained at the temperatures to which the thermo-couple will be subjected. Wire ranging in size from No. 14 to No. 6 Brown & Sharpe gage (0.064 to 0.162 inch in diameter) is generally employed. The most commonly used thermo-couples are made of chromel-alumel, although some are made of iron-constantan for lower temperature applications, and platinum, platinum-rhodium is used for higher temperatures.

Wires are cut to the desired length and straightened, after which their ends are cleaned by grinding. Each pair of dissimilar metal wires is then joined at one end by oxy-acetylene welding. Low gas pressures (approximately 5 pounds per square inch) are used, and a welding flux is employed to facilitate the flow of the metals and keep them clean. Small-diameter wires are sometimes twisted together before welding to provide additional strength. Chromel-alumel thermo-couples are annealed at 1200 degrees F. after welding and before testing.

The special electric furnace, Fig. 1, employed for testing thermo-couples consists of an insulated cylindrical metal shell containing a steel-alloy pot that is filled with molten lead. The pot extends into the furnace for about one-half of its depth, and the sides are about 1 inch from the electrical heating elements mounted on the walls of the furnace. Covering the pot is a Transite disk, 1 inch thick, in which are mounted alloy-steel thermo-couple protecting tubes that extend down into the lead. A 3-inch layer of insulation is provided in the furnace cover. Holes in the insulation permit placing the master thermo-couple and the thermo-couples to be tested in the protecting tubes. Since the tubes do not extend up through the insulation, practically no heat is conducted away from the furnace.

With this arrangement, the furnace temperature can be kept practically constant—a prerequisite for accurate thermo-couple testing. Variation in furnace temperature seldom exceeds 0.25 degree F. after days of continuous operation. The temperature of the furnace is controlled by a thermo-couple placed in the bottom

Fig. 1. A special electrically heated testing furnace, seen at left, a master thermo-couple, and a precision potentiometer indicator (right) are employed to calibrate manufactured thermo-couples

of the furnace, near the heating elements, but away from the lead pot, and a potentiometer control instrument having its resistance in series with the heating elements. Two or three thermo-couples to be tested can be placed in each of the holes provided in the furnace cover. A portable precision potentiometer, seen at the right in Fig. 1, is employed to measure the electromotive forces developed by the various thermo-couples. An allowance of ± 5 degrees F. is permitted, but, as previously mentioned, the thermo-couples can be checked within less than 1 degree F.

Thermo-couple terminal blocks are insulated from the heat of the furnaces and kept as close to room temperature as possible. The depth at which the thermo-couple is located in the furnace is of major importance in accurate temperature control. The depth varies with the furnace, and can only be determined from experience. A thermo-couple depth of about 8 inches has been found most suitable for the furnaces installed at the Allison plant. For greatest accuracy, the wires leading from thermo-couple to control instrument should be made from the same metals as the thermo-couples. All lead wires are passed through one protective duct to prevent induction or the pick-up of stray electrical currents which might affect the accuracy of the temperature reading.

Temperatures of the various furnaces are controlled by Micromax recording or indicating instruments made by the Leeds & Northrup Co. In this galvanometer type potentiometer, the electromotive force generated by the thermo-couple is balanced against an adjustable, standard electromotive force. The resistance offered by the lead wires does not affect the accuracy of temperature measurement, and the controllers can be placed any distance from the thermo-couples. Temperature controllers for all furnaces are therefore grouped together, as shown in Fig. 2, to facilitate control of the heat-treating cycles.

Iron-constantan thermo-couples, operating continuously at a temperature of about 1600 degrees F., are changed every week. Chromel-alumel thermo-couples are changed after from three to six months' operation, depending upon the temperatures to which they are subjected and whether their operation is continuous or intermittent. Thermo-couple protection tubes are inspected every six months, and temperature control instruments are overhauled and recalibrated after the same period of operation.

The search for materials suitable for use in turbo-jet aircraft engines is the subject of a continuous and intensive research and development program. At present, the steels employed for parts of these engines may be grouped into the following four general classifications:

1. Oil-hardening grades of steel, such as Aeronautical Material Specification 6415 (S A E

4340), employed for highly stressed parts, like bolts.

2. Oil-hardening grades of steel, such as AMS 6320, 6322, 6448, and 6382, for less highly stressed parts.

3. Carburizing grades of steel, such as AMS 6260 (S A E 3312), employed for practically all gears and certain shafts.

4. Nitriding grades of steel for certain shaft extensions.

Heat-treatment of the oil-hardening grades of steel follows conventional practices, with the exception that the temperature of the furnace and quenching oil is more closely controlled. Typical of the heat-treatments for these steels are those performed on AMS 6415 (S A E 4340) steel parts for turbo-jet engines.

All AMS 6415 forgings are normalized at 1750 degrees F. to produce the most suitable structure for good machinability. The parts are then machined, cleaned in a vapor degreaser, and heated to a temperature of 1500 to 1525 degrees F. for thirty minutes. The hardness, following an oil quench, is about 57 Rockwell C. A standard petroleum oil of 100 viscosity is employed for all quenching operations. The oil is maintained at a temperature of 118 degrees F., within ± 5 degrees, by passing it through a heat exchanger that is heated by means of steam and cooled by cold well water.

Hardened parts are again degreased, and then tempered. The tempering temperature varies with the desired hardness, as shown on the hardness-temperature curve, Fig. 3. Parts that will be subjected to high stresses in the engine are tempered at 1100 degrees F., resulting in a hardness of 35 Rockwell C. Parts requiring additional machining are tempered at 1175 degrees F., giving a hardness of 33 Rockwell C. The toughness of bolts is increased by tempering at 1275 degrees F., which reduces their hardness to about 29 Rockwell C. A minimum of one hour for each 3/4 inch of thickness in the largest section is required for tempering.

Techniques Employed in Carburizing

Forged gears and shafts made from S A E 3312 steel are normalized at 1750 degrees F. to obtain the most suitable machining structure

Fig. 2. Recording or indicating temperature control instruments for all furnaces are grouped together in order to facilitate regulation of the various heat-treating cycles

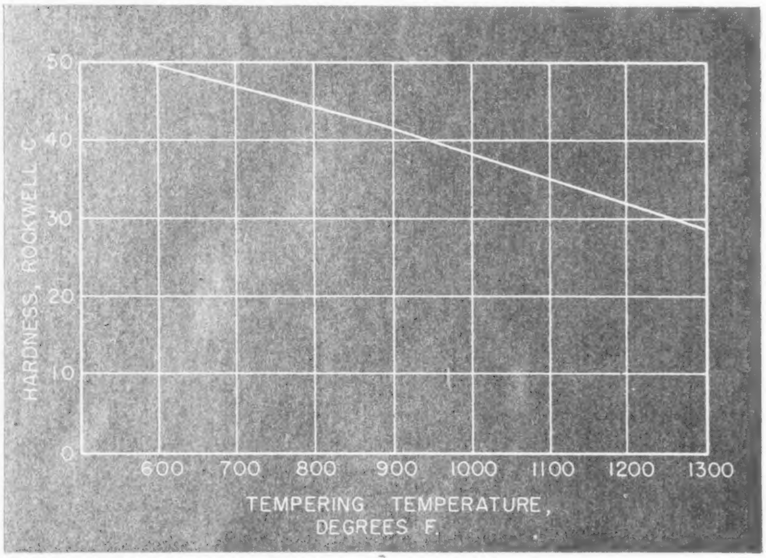


Fig. 3. Hardnesses obtained for various tempering temperatures in treating an AMS 6415 steel bar, 1 inch in diameter, which was oil-quenched from a hardening temperature of 1525 degrees F.

having a Brinell hardness of 217 to 255. Distortion of these parts may occur during subsequent carburizing as a result of relieving the strains introduced by the tool pressures during machining. Such distortion can be minimized by heating the parts to 1200 degrees F. and cooling in air before carburizing. This stress-relieving treatment is followed by a light machining operation to true the parts.

The machined parts are degreased and then core-hardened in electrically heated Leeds & Northrup Vapocarb-Hump furnaces. The furnace is heated to a temperature of 1550 degrees F., and the parts are held at this temperature for a minimum of thirty minutes. Atmosphere control is provided by a separate electrically heated cracking furnace. Vapocarb fluid is fed into the cracking furnace at a controlled rate, and is automatically converted into a gas that flows into the bottom of the hardening furnace. An atmosphere containing approximately 17 per cent carbon monoxide completely fills the hardening furnace, finally burning off at an exhaust vent. Parts are loaded on special fixtures to prevent distortion at the hardening temperature and to allow free circulation of oil around the parts during the quenching operation that immediately follows heating.

Quenched parts of S A E 3312 steel, having a hardness of about 41 Rockwell C, are again degreased and then tempered for two hours at 1050 degrees F. to obtain a hardness of from 26 to 30 Rockwell C. Selective carburizing is accomplished either by the copper-plating method or by allowing sufficient stock on those surfaces from which the case is to be machined after carburizing. Alkali paints are never employed for selective carburizing. A copper deposit from 0.0004 to 0.0006 inch thick is plated on the parts. In the copper-plating process, the parts are subjected to a copper strike bath having a current density of 45 to 50 amperes per square foot for forty-five seconds, and then immersed in a copper-plating solution having a current density of 30 to 35 amperes per square foot for about forty-five minutes.

All parts made from this type of steel are gas-carburized in electrically heated Homocarb furnaces, such as the ones shown in Fig. 4. The parts must be thoroughly cleaned before carburizing, since any foreign material adhering to their surfaces will interfere with the carburizing action. Parts to be carburized are carefully loaded into baskets to prevent distortion during the operation and interference with the carburizing action. Heat-resistant alloy-steel spacers are employed to separate certain parts, such as thin-webbed gears. A test specimen is placed on top of the load, and two more specimens are suspended in the furnace by inserting them through the vent after closing the furnace lid.

A closely controlled temperature of 1650 degrees F. is maintained in the carburizing fur-

nace. Homocarb fluid, which is a specially prepared hydrocarbon oil, is fed to the furnace at a controlled rate from a centrally located pumping system. "Flo-Scopes" are employed to regulate the fluid flow, which varies from 3/8 pint to 1 1/4 pints per hour, depending upon the depth of case desired. The fluid is cracked within the furnace into a uniform carbon-rich gas, which is forced through the load of parts by a high-pressure fan located below the work.

One test specimen is removed from the furnace thirty minutes before the end of the carburizing cycle to determine the case depth. The heat is turned off, but the flow of carburizing fluid is continued until the furnace has cooled to a temperature of 1500 degrees F. A second test specimen is withdrawn at the end of the cycle.

At the completion of the carburizing and diffusing cycle, the rotation of the fan and the flow of liquid are stopped, the relief cap on the furnace lid opened, the lid raised and swung aside, and the load transferred to a cooling pit, as seen in Fig. 4. The cooling pit is also provided with a controlled atmosphere to prevent decarburization of the parts while they cool through the transformation range. When the parts have reached a temperature of 600 degrees F., they are removed from the pit and allowed to cool in air at room temperature. A case hardness of from 57 to 58 Rockwell C, and a core hardness of 37 Rockwell C, result from this treatment of S A E 3312 steel parts.

Depth of carbon penetration and concentration can be varied by changing the cycle time, the amount of fluid flow, and the temperature. By careful control of these variables, carburizing depths can be controlled within 0.005 inch. Case depths vary from 0.015 to 0.070 inch, depending upon the application of the part. Splines are usually carburized to a depth of 0.015 to 0.020 inch, small gears from 0.025 to 0.030 inch, highly loaded gears from 0.035 to 0.040 inch, and parts subject to excessive wear up to 0.070 inch deep. The time required for the carburizing cycle varies from 1 1/4 hours for a case depth of 0.015 inch to thirteen hours for a depth of 0.070 inch.

If machining is required prior to hardening, such as is the case in selectively carburized parts

Fig. 4. At the completion of the carburizing cycle, the work load is transferred from the furnace to a pit for cooling to a temperature of 600 degrees F.

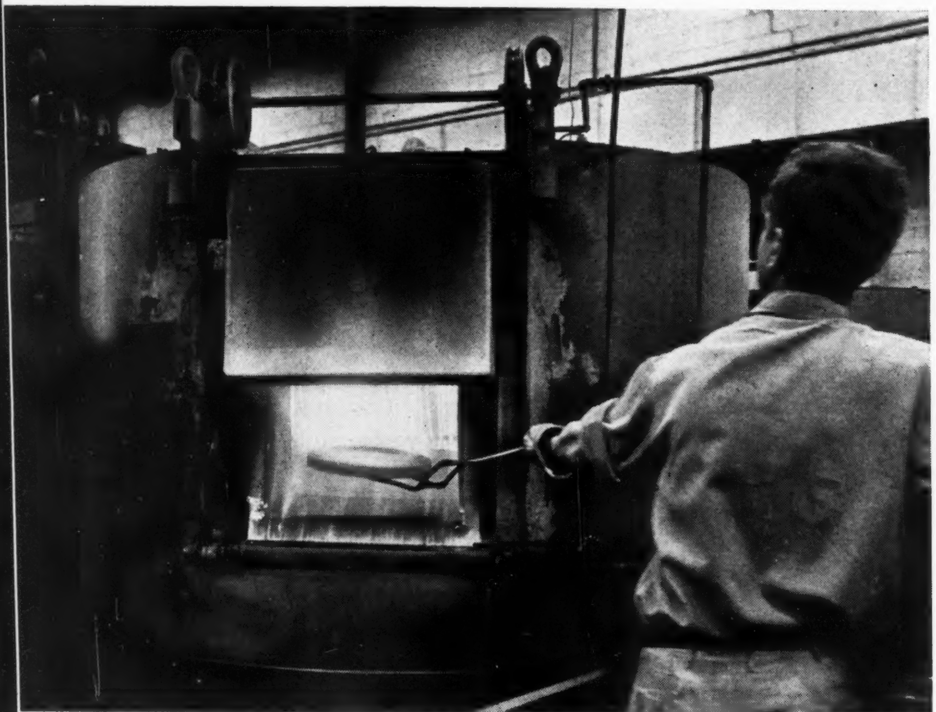


Fig. 5. Carburized parts are hardened in electrically heated, controlled-atmosphere, rotary furnaces at a temperature of from 1475 to 1500 degrees F.

that are not copper-plated, the parts are annealed after carburizing. This is accomplished by reheating the load of carburized parts to 1380 degrees F. in a controlled-atmosphere furnace for at least one hour. The parts are then allowed to cool in the furnace to a temperature of 1100 degrees F., maintained at this temperature for one hour, transferred to a cooling pit until they reach 600 degrees F., and finally removed from the pit for cooling to room temperature. Parts that do not have to be machined after carburizing are reheated to 1175 degrees F. for two hours and then cooled in air.

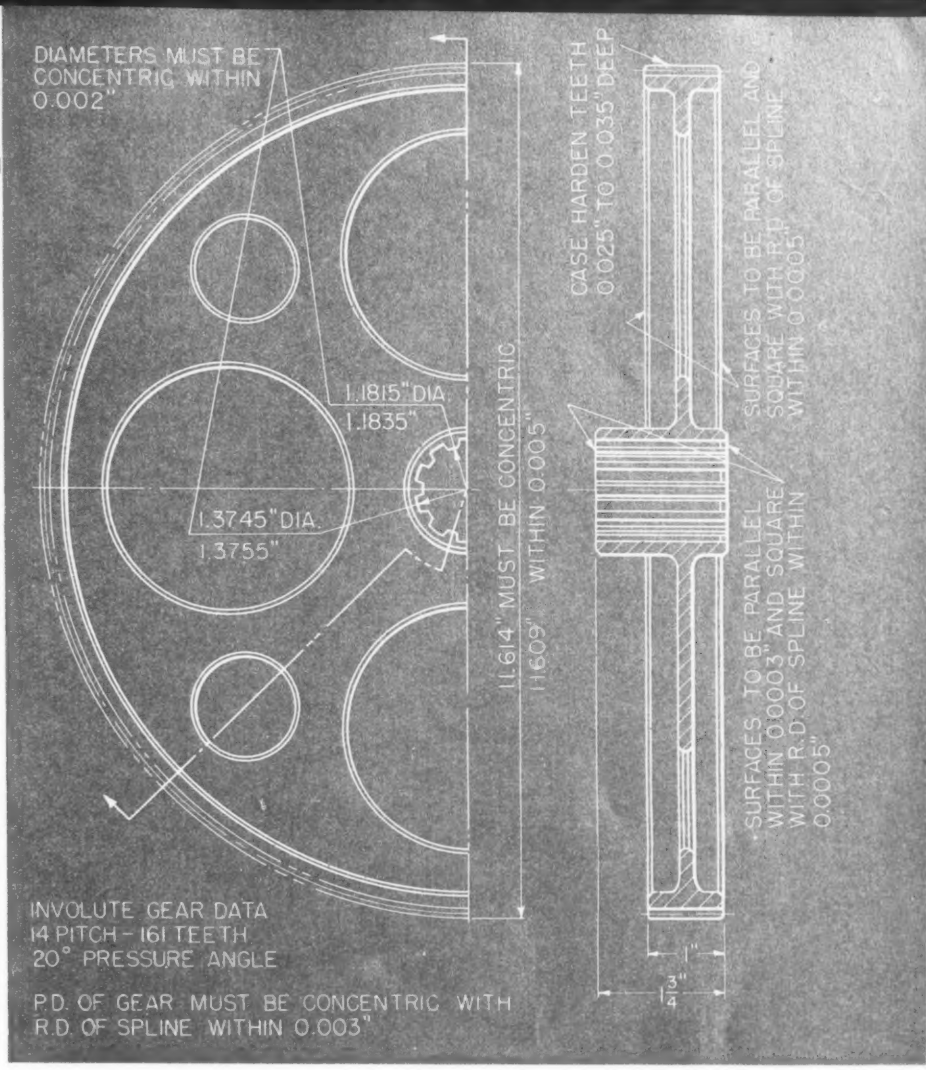
Hardening of Carburized Parts

Carburized parts are hardened in Westinghouse rotary furnaces, such as the one seen in Fig. 5. These electrically heated furnaces have an auxiliary heated retort for cracking artificial

Fig. 6. Starter gears for turbo-jet aircraft engines are held between dies while being quenched in this press to minimize distortion

Fig. 7. (Right) Dimensions and tolerances maintained on the carburized starter gear shown being hardened and quenched in Figs. 5 and 6

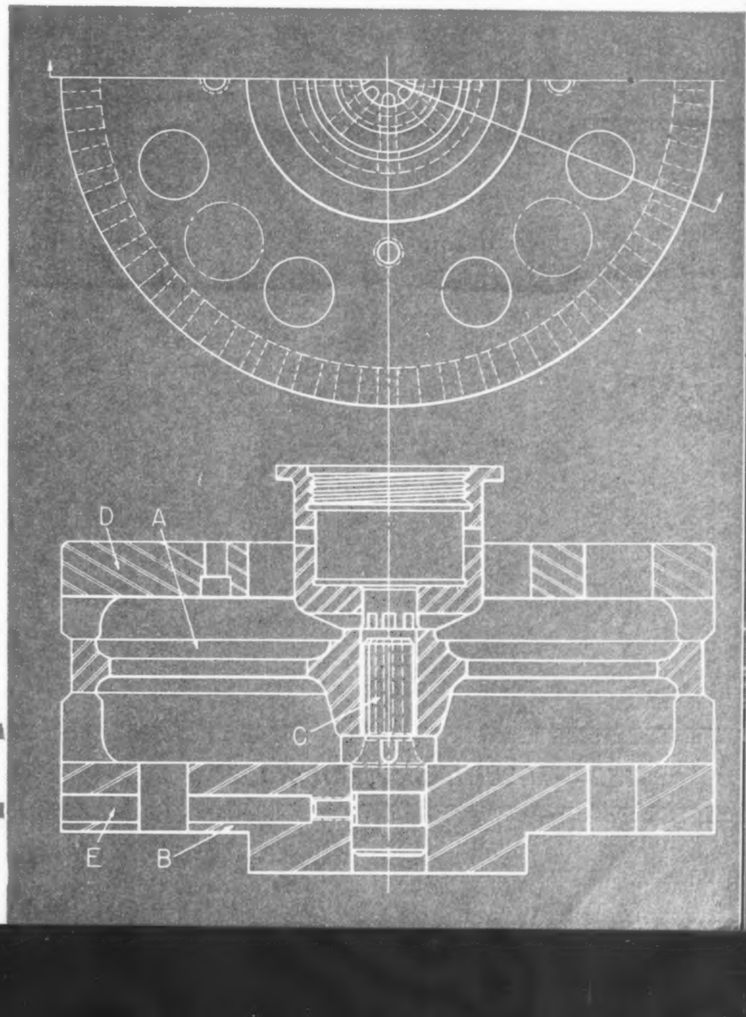
Fig. 8. (Below Right) Die employed for holding heated gear A during quenching to prevent distortion. Oil flows upward through hollow plug C to quench both sides of the gear simultaneously



gas. The protective atmosphere employed in the furnace contains from 15 to 18 per cent carbon monoxide and effectively prevents decarburization of the parts. An atmosphere-control "curtain" is provided by a slot type burner that extends the full width of the furnace opening to prevent the entrance of air.

The parts to be hardened are held at a temperature of 1475 to 1500 degrees F. for at least thirty minutes, after which they are immediately quenched in oil. The quenching operation is performed in Gleason quench presses, such as shown in Fig. 6. Tolerances maintained on the starter gear seen being hardened and quenched in Figs. 5 and 6 are indicated in Fig. 7.

The quenching fixture employed for preventing distortion of the starter gear is shown in Fig. 8. Heated gear *A* is placed on lower die *B*, being located from plug *C*. Upper die *D*, mounted on the air-operated ram of the quenching press, is automatically lowered into contact with the work-piece. Quenching oil flows from a pump into hole *E* in the lower die. Part of the oil flows out of the vertical holes in the lower die, thus



quenching the under side of the gear, while part flows upward through the hollow plug to quench the top surface of the gear. Such an even flow of oil to both sides of the part is essential to maintain straightness and minimize distortion, especially on large-diameter parts.

Carburized, hardened, and quenched parts have a case hardness of from 62 to 63 Rockwell C, and a core hardness of from 38 to 41 Rockwell C. The parts are drawn for one hour at 300 degrees F. to relieve stresses, and cooled in air. Parts that have been copper-plated for selective carburizing are then stripped of copper.

The hardness of the carburized case on the gear teeth is inspected by means of a special fixture mounted on the table of a Rockwell superficial hardness tester, as shown in Fig. 9. The gear to be tested is supported between a tooth mounted on a block at the right of the fixture and a gear segment at the left, both of which have been cut from the same type gear as the one being tested. A counterbalancing arm extends from the block at the right to balance the fixture on the table. The gear segment is mounted on a sliding block to accommodate gears of various diameters. In making the test, a load of 30 kilograms and the 30-N scale of the hardness tester are employed. The extension spindle of the tester is cut out at the lower end so that the diamond Brale penetrator can contact the pitch line of one of the gear teeth.

Fig. 9. Rockwell hardness of the carburized case is tested directly on the pitch line of the teeth by an instrument equipped with a cut-out extension spindle and a special gear-holding fixture

Procedure Followed in Nitriding

Forgings of nitriding grades of steel are also normalized at 1750 degrees F. to facilitate machining. After machining and degreasing, the parts are core-hardened by heating to a temperature of 1700 degrees F. for thirty minutes in a controlled-atmosphere furnace and quenching in oil. A tempering treatment of 1150 degrees F. for two hours, followed by air cooling, results in a hardness of 33 to 37 Rockwell C.

After being finish-machined and degreased, the parts are ready for nitriding. From 1/16 to 1/8 inch of stock is machined from the diameters of the parts to insure the removal of any decarburized metal. Decarburized surfaces on the parts before nitriding will cause excessive dimensional changes and soft spots. Thorough cleaning is an essential requirement of good nitriding practice, since foreign material adhering to the surfaces of the parts will interfere with the nitriding action.

Parts will increase in size slightly during the nitriding operation, the amount of such change varying with the cycle time and temperature, the shape of the part, and the area of the surface to be nitrided. In general, the diameter of the parts will increase approximately 0.001 inch per inch of diameter. The allowance necessary for parts of intricate design can only be determined by experimentation.

Nitriding is performed in Homo nitriding fur-

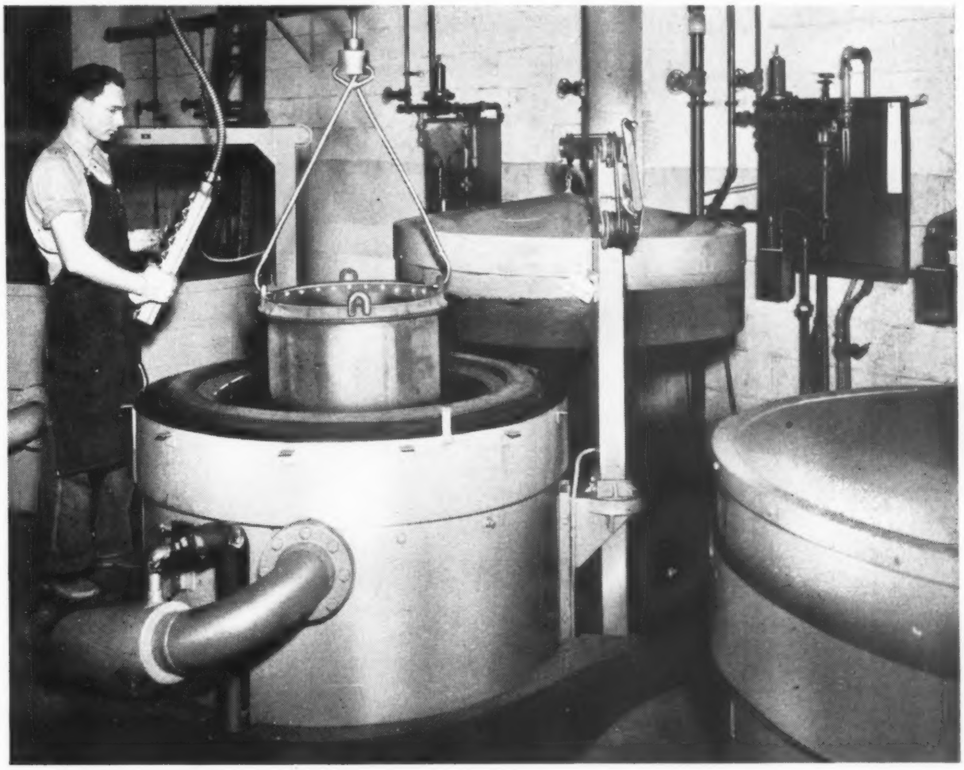


Fig. 10. A load of parts to be nitrided is lowered into the furnace. The nitriding cycle consists of heating the parts to 975 degrees F. for forty-eight hours, with 30 per cent dissociation, to obtain a case depth of 0.018 inch

naces, such as the one seen being loaded in Fig. 10. Parts to be nitrided are placed in the basket and lowered into the cylindrical work space, which is separated from the electric heating coils by a radiation shield. The oil-sealed furnace lid is then swung into place, to make a gas-tight heating chamber. Ammonia gas enters the furnace through a port in the lid. The rate of gas flow is set at 40 cubic feet per hour, and this rate is continued until the air content of the furnace is less than 10 per cent, as indicated by the dissociation pipette seen in the background at the right.

A fan at the bottom of the furnace carries the gas past the heating coil and into the load. The fan automatically reverses its direction every minute, so that the gas reaches all parts of the work. When the ammonia gas enters the furnace, which is maintained at a temperature of 975 degrees F., it is dissociated into nitrogen and hydrogen. The amount of dissociation is maintained at 30 per cent by keeping the rate of gas flow at 25 cubic feet per hour. Gas exhausted from the furnace passes through the pipette, thus indicating the dissociation.

After forty-eight hours, the heat is turned off, but rotation of the fan is continued. Water is circulated through a manifold around the furnace for rapid cooling. The rate of ammonia flow is increased to 30 cubic feet per hour to compensate for contraction of the gases during the cooling period. When the furnace has cooled to 350 degrees F., the flow of ammonia gas is stopped, the furnace lid is raised, and the parts are removed from the furnace and allowed to cool in the air to room temperature. Following this treatment, the case hardness varies from 67 to 68 Rockwell C, while the core hardness remains at 32 to 36 Rockwell C. The case depth resulting from the heat-treatment outlined does not vary more than $\pm$ 0.001 inch from the desired 0.018 inch.

There is soft, unstable skin from 0.001 to 0.002 inch thick on the surface of nitrided parts. This skin is removed from all surfaces subject to wear by grinding or lapping from 0.002 to 0.004 inch of stock from the diameter of the part. Good nitrided surfaces have a gray matte appearance, while a shiny or lustrous surface indicates a poor case.

Grumman F9F-2 "Panther" Jet Fighter

Sheet-Meta[l] ... Require[...]

By GEORGE H. DeGROAT

TURBO-JET engines, designed for the high-speed flight of aircraft, require large amounts of sheet metal. Many important assemblies of these engines, such as the combustion chambers, exhaust units, discharge nozzles, cooling air manifold cases, etc., are made up chiefly of sheet-metal details. These parts are produced and assembled to extremely close tolerances at Pratt & Whitney Aircraft Division of United Aircraft Corporation, East Hartford, Conn., for use in the JT-6 "Turbo-Wasp" jet engine shown in the heading illustration.

The drawing of this engine, Fig. 1, indicates the elevated temperatures and high velocities of gases encountered in operation, from which it is apparent that the sheet-metal parts must be able to withstand high temperatures and fatigue resulting from high velocity air flow. In order to stand up in service over an appreciable time, these parts must be precisely made from high-strength heat-resistant materials.

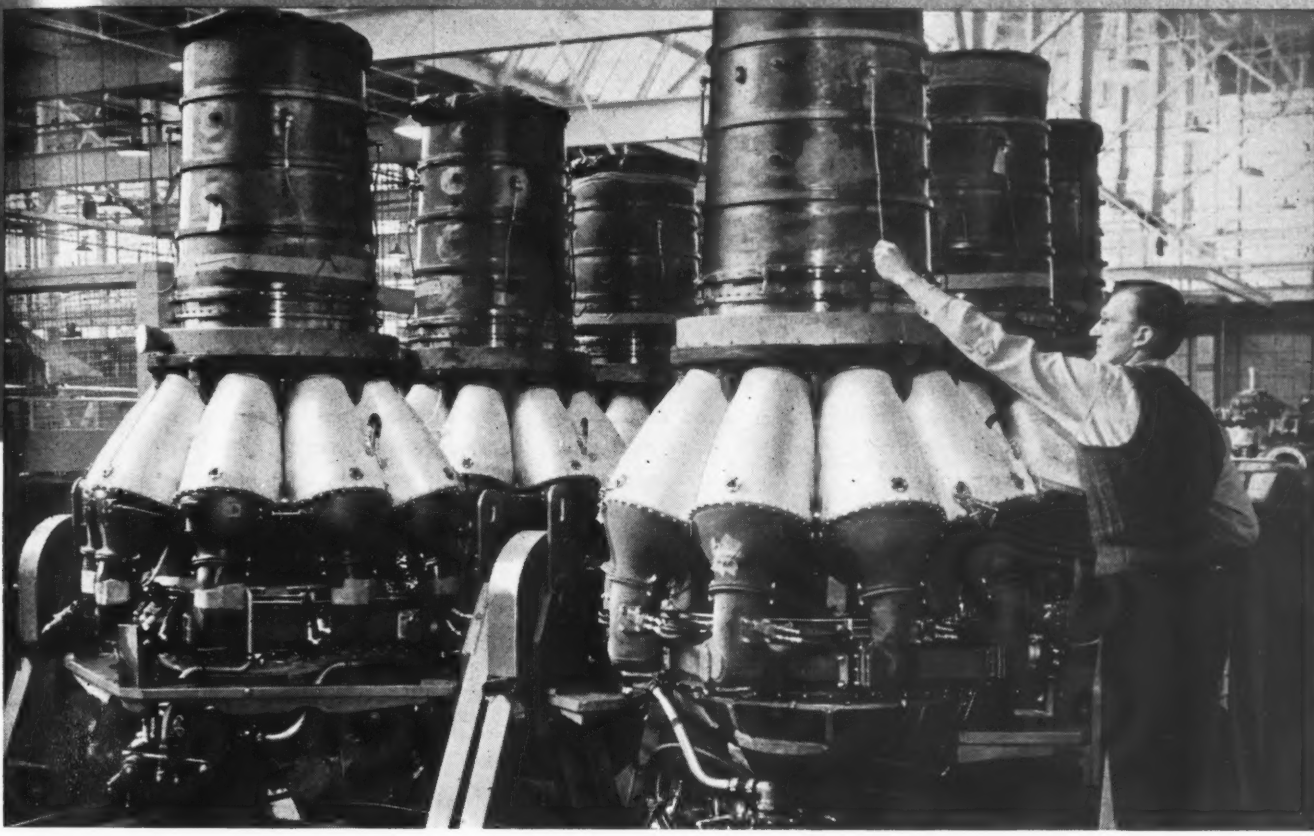
One of the principal materials used is a heat-resistant chromium-nickel-iron alloy known as Nimonic 75. This austenitic material, containing approximately 78 per cent nickel and 20 per cent chromium, maintains strength at red heat, and has great resistance to oxidizing, reducing, and other high-temperature corrosive atmospheres. Stainless steel of 18-8 analysis (Aeronautical Materials Specification 5510 and 5512) is also used extensively, as is low-carbon sheet metal (AMS 5040).

Sheet-metal details of the "Turbo-Wasp" are stamped, deep-drawn, or rolled and welded. The combustion chamber, illustrated in Fig. 2, consists of sub-assemblies representing all three methods of manufacture. It has an inner liner, or flame-tube scoop, which is deep-drawn from Nimonic sheet; a swirl vane assembly, which aids in stabilizing combustion in the flame tube, consisting of Nimonic vanes and a stainless-steel outer shroud, stamped in mechanical presses; and a flame-tube front which is a rolled and welded part made of 0.048-inch Nimonic sheet.

The components of the combustion chamber, or burner, are severely stressed because it is in this unit that atomized fuel is mixed with compressed air and burned, producing high-velocity gases which drive the compressor and are discharged through the exhaust unit at high speed to produce the propulsive jet of the engine. In a turbo-jet engine, approximately 60 per cent of the energy is used in driving the compressor, the balance being available as jet thrust.

When it is necessary to maintain high surface finishes on the sheet metal during processing, a liquid-plastic envelope and paper are used. One example of the care taken in protecting surfaces may be seen in Fig. 3, where aluminum sheets, polished to a surface finish of 15 micro-inches,

Components for Turbo-Jet Engines Exact Manufacturing Methods



r.m.s., are being wrapped in paper before blanking. The blanks are made into toroidal air-inlet vanes that control the direction of air flow to the compressor. To protect the surface of the metal from scratches during the drawing, forming, and trimming operations, the blanks are coated with a liquid plastic.

Stainless-steel sheets are held to a thickness tolerance of plus or minus 0.005 inch as purchased, and Nimonic sheets of the most widely used thicknesses must be within plus or minus 0.003 inch of the basic thickness. Blanks for parts that are to be deep-drawn are checked for thickness at the presses.

Control over material thickness is maintained, not only because of initial drawing die clearance considerations, but also because of the exacting requirements for mating fits in welding. Moreover, many smaller parts are made from the trimmings and centers of drawn parts. Supports used between the combustion chamber outer liner, or burner shell, and the flame tube, for example, are stamped from 0.064-inch Nimonic trimmings of the drawn flame-tube window piece. Besides using these trimmings for parts, they are employed to make test pieces for inspecting the efficiency of welded joints. Such test pieces are of great importance in the quality control of welded assemblies.

One of the most interesting deep-drawn parts in the combustion-chamber assembly is the flame-tube flare. This part, which is made of 0.048-inch Nimonic sheet, requires six draws, as illustrated in Fig. 4, each of which is followed by bright annealing. Inasmuch as deep-drawn parts are subjected to severe cold-working, the depth of each draw is calculated on the basis of the degree of work-hardening that occurs. Individual

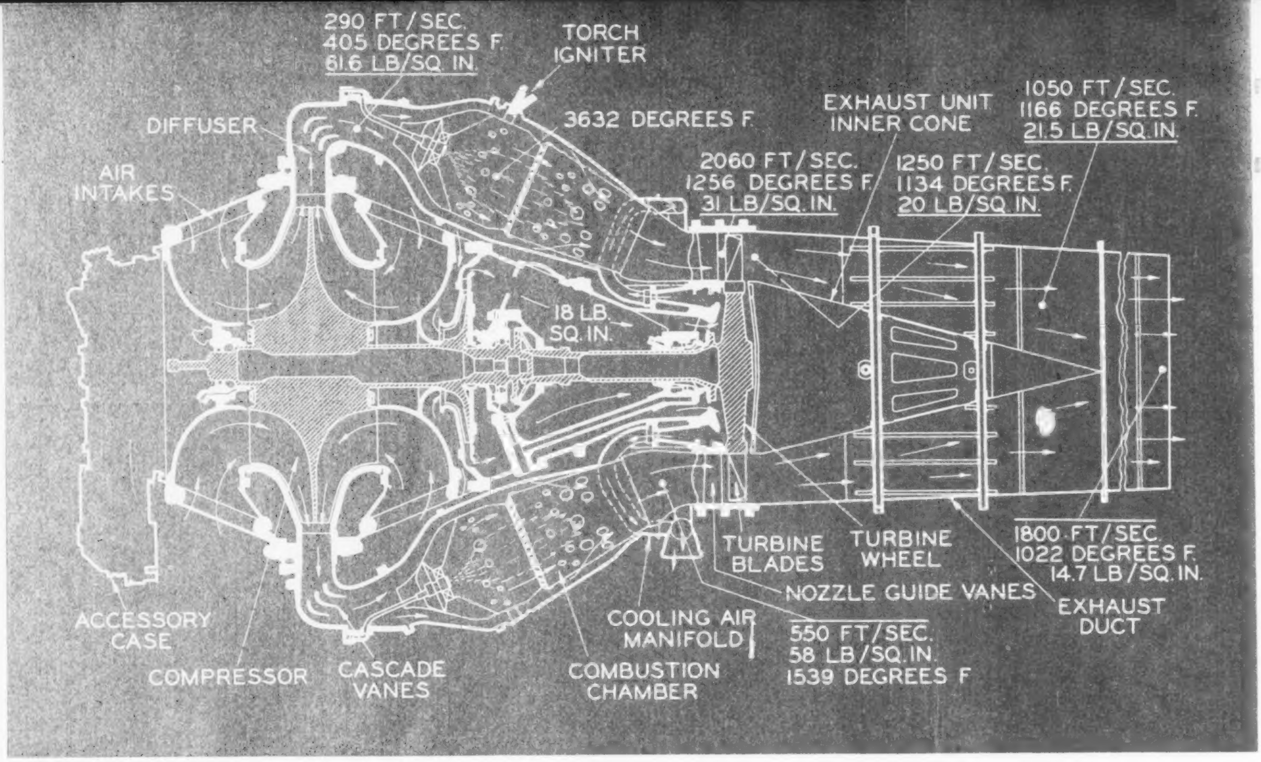


Fig. 1. Cross-sectional diagram of Pratt & Whitney JT-6 "Turbo-Wasp" engine, showing the flow of high-velocity gases and the elevated temperatures produced in some of the principal sheet-metal components

depths of draw are held precisely by either a positive stop in the dies or by reversing the press stroke at a predetermined pressure, which not only maintains calculated draws, but also insures accurate location and forming of the work in subsequent drawing operations.

Following the last draw (see Fig. 5), the flare is restruck, a lip formed, and a large hole pierced in the small end. The large end is then cut off and sixty holes are pierced in the piece. After piercing ninety more holes, the edges of the holes are formed to a radius. Piercing, slotting, trimming, and other operations required on deep-drawn parts of this type are accomplished in mechanical presses to close tolerances. Slots are often required to permit expansion of the part

Fig. 2. Cross-sectional diagram of the combustion chamber, or burner, illustrating the assembly of stamped, deep-drawn, and rolled and welded sheet-metal parts

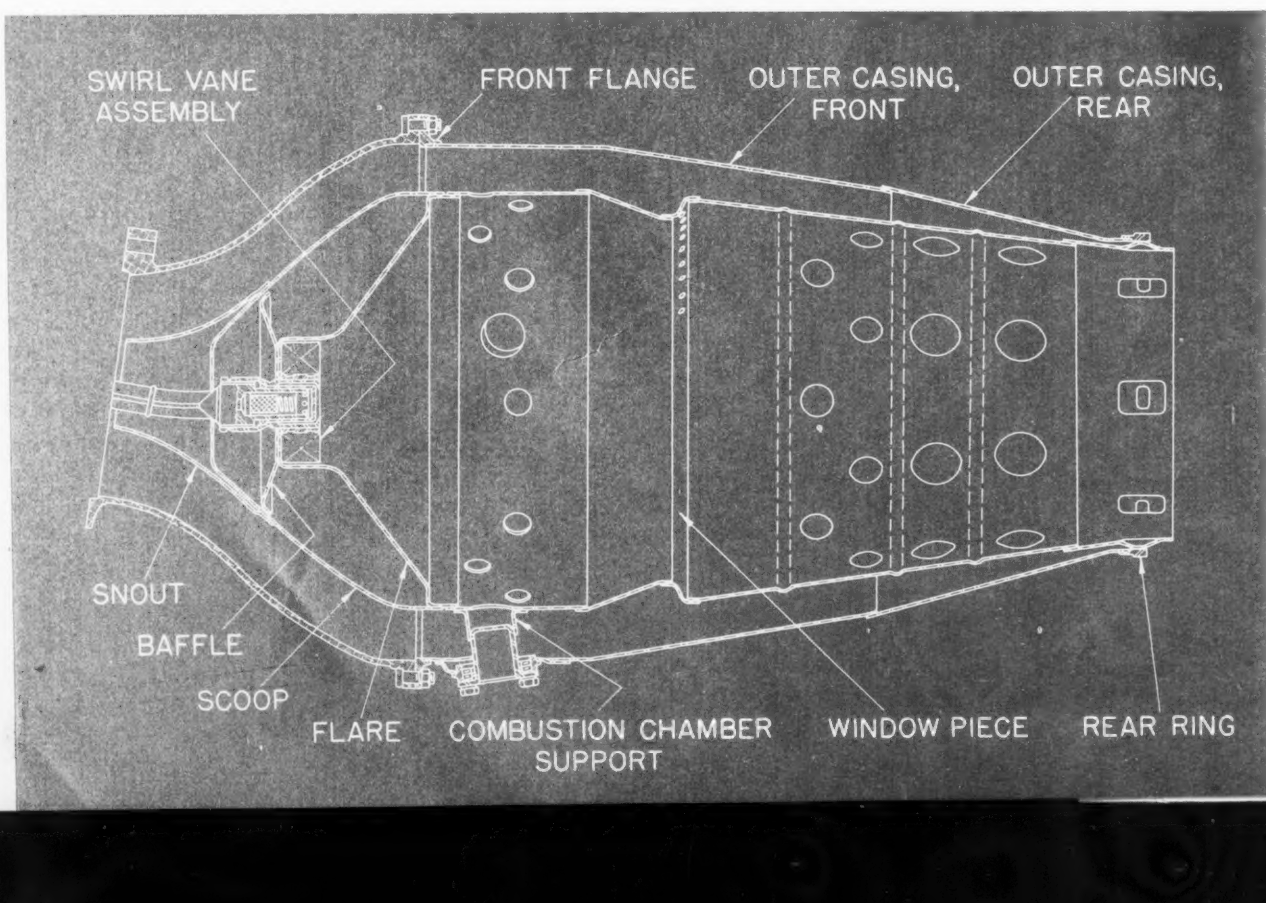


Fig. 3. Highly polished aluminum sheet for toroidal air-inlet vanes is wrapped in paper to protect the surface during processing

at the high temperatures encountered in operation. One of these slots can be used for accurately locating the part during processing and assembling. In cases where parts do not require slots, a construction hole is provided for this purpose.

Another deep-drawn component of the combustion chamber shown in Fig. 2 is the flame-tube fairing or snout. Beginning with a Nimonic blank 8 3/4 inches in diameter, this part, like the one just described, requires six draws, as indicated in Fig. 6. Each draw is followed by bright annealing, as is the case with all of these deep-drawn parts. Mechanical press operations follow drawing, some of which include offsetting the form, piercing a construction hole, trimming, slotting, etc.

Nimonic 75 and 18-8 stainless steel, being austenitic, require comparatively slower press speeds to reduce work-hardening and to permit deeper individual draws. Hydraulic presses, Fig. 8, ranging in capacity from 50 to 400 tons are employed for deep-drawing these materials. One of the most difficult drawn parts made in these presses is the bar sleeve. These parts are assembled in the duct of the exhaust unit, where they must withstand the force of the discharged gases. Hence, they are accurately drawn from stainless-steel sheet to achieve high strength.

All work is annealed between draws in a Westinghouse controlled-atmosphere furnace of the roller-hearth type, Fig. 9, to restore the ductile characteristics of the original metal structure. By surrounding the work with a neutral gas to exclude oxygen, the controlled atmosphere prevents the formation of scale on the work, so that subsequent draws are made with a minimum loss of the basic material and drawing dies are not scored by scale. Parts drawn of heat-resistant alloys are annealed at temperatures of 1900 to 1950 degrees F. for seven to ten minutes.

Fig. 4. Six draws are required to produce the heat-resistant flame-tube flare. Each draw is followed by bright annealing

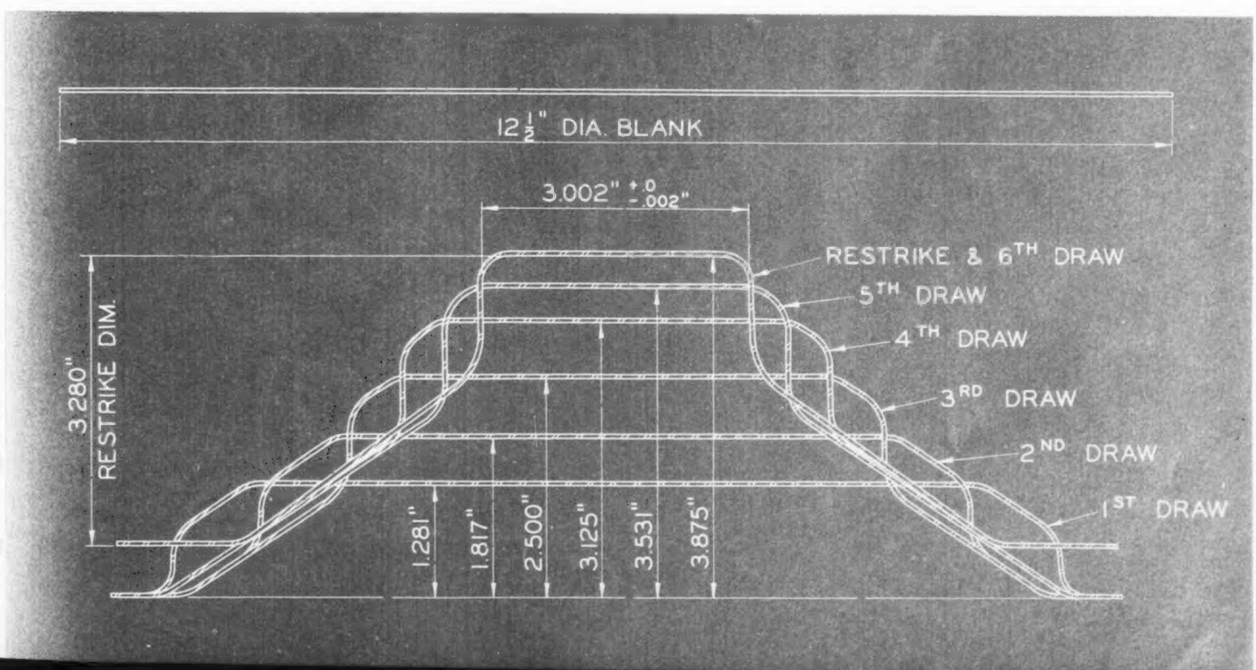


Fig. 5. Flame-tube flare shown at left after fifth draw, and at right after sixth or final draw

Promptness in annealing after drawing is necessary because of the possibility of spontaneous cracking of the material, especially with deep-drawn 18-8 stainless steel.

All drawn parts are thoroughly cleaned and degreased before annealing to avoid contaminating the surfaces with charred lubricants or foreign material. In this connection, it is essential that the drawing compound have properties that facilitate its removal. Although high pressures and frictional temperatures result from the use of heavy-bodied lubricants, a high viscosity is required to maintain a continuous film on these austenitic, chrome-nickel alloys, which have a high initial stiffness and harden rapidly in cold-working. To achieve high film strength, heat resistance, adhesiveness, spreading power, and the important quality of easy removal, a drawing lubricant combining mineral and fatty oils, fortified by sulphur and chlorides, with a mica additive, is used for this work.

A very thin coating of oxide formed on the surface of the work during annealing is removed by means of a pickling process. This consists essentially of a hydrofluoric acid bath, fol-

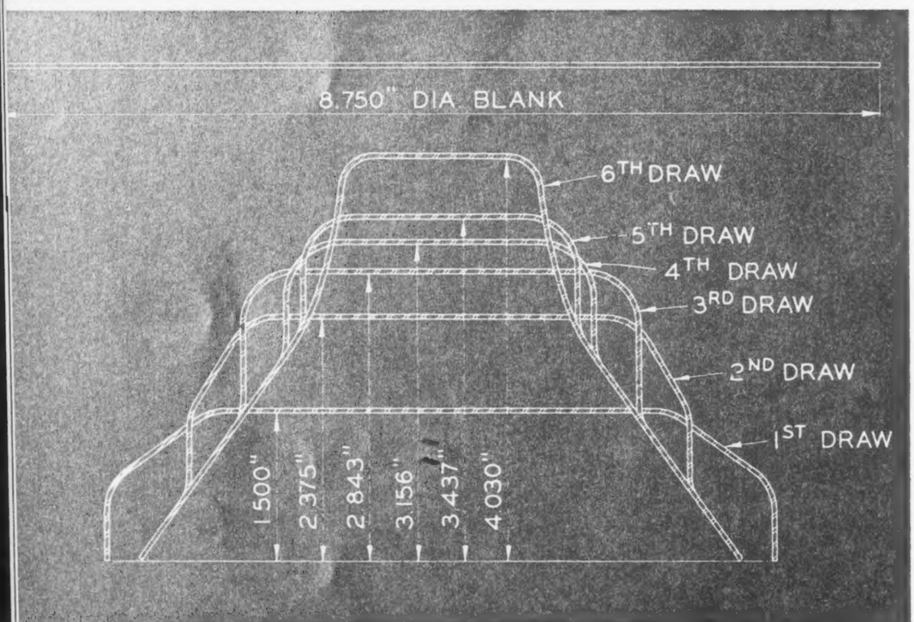


Fig. 6. (Center) Flame-tube snout is formed to close tolerances in six draws

Fig. 7. (Left) Baffles for flame tube are blanked, pierced, and trimmed from alloy strip

lowed by a water wash, a neutralizer, and a water rinse. Anhydrous ferric sulphate (Ferrisul) is employed in this bath to speed the action, and at the same time, to protect the base metal. By removing this oxide film, the process not only aids in maintaining the corrosion resistance of the material, but also improves its drawing quality, as the pickled surface helps to retain the drawing compound.

Other members of the combustion chamber that may be considered representative of deep-drawn parts include the flame-tube scoop. Made of Nimonic sheet, this part requires three draws, each followed by annealing, after which a restrike is made and a large hole pierced in it. After cutting off the large end, keyhole slots and drain holes are pierced. The combustion-chamber supports, three of which support the flame tube in the burner shell, are given four draws, after which the drawn ends are cut off, a restrike made to set them at an angle, the outside diameters trimmed, and the inside diameters bored. Other operations include facing and chamfering, saw slotting, and piercing holes in the ends of the slots.

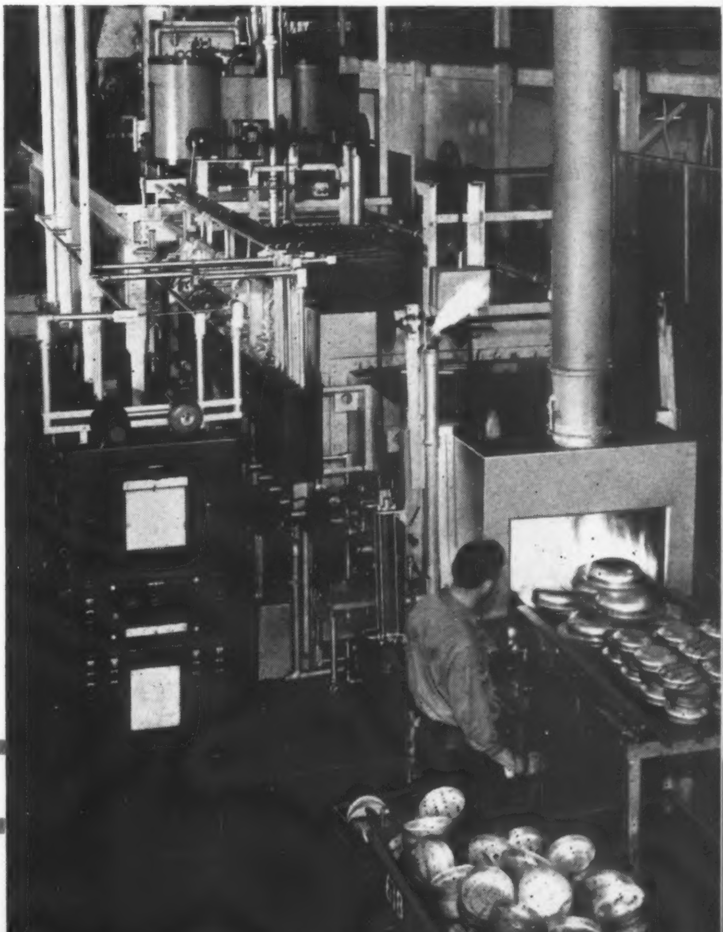
Various die materials are used, depending upon the design and material of the drawn part, to obtain accurate forms, long die life, and maximum drawing efficiency. Meehanite and nickel-alloy cast-iron dies are used for drawing large Nimonic parts of the burner shell and flame tube. The original wear resistance of these dies is increased as they are used because their surfaces work-harden. Aluminum-bronze alloy dies are used extensively for small parts made of Nimonic material. These and carbide dies are applied where sharp radii are required and where the form desired is such that tool-steel dies would wear excessively.

Some dies are made of boiler plate and have hardened tool-steel facings ground to required contours. Among the parts formed in dies of this type are the stainless-steel discharge nozzles that connect the combustion chambers to the turbine section of the engine. These parts are drawn and formed in halves, which are later cut into two pieces to obtain the sides of the discharge nozzle. The nozzle sides are joined by gas-shielded metal arc-welding.

Many small details are included among the

Fig. 8. A battery of hydraulic presses ranging in capacities from 50 to 400 tons is used for deep-drawing operations on precision sheet-metal parts

Fig. 9. Controlled-atmosphere furnace of globar roller-hearth type is employed for the bright annealing of sheet-metal parts between draws



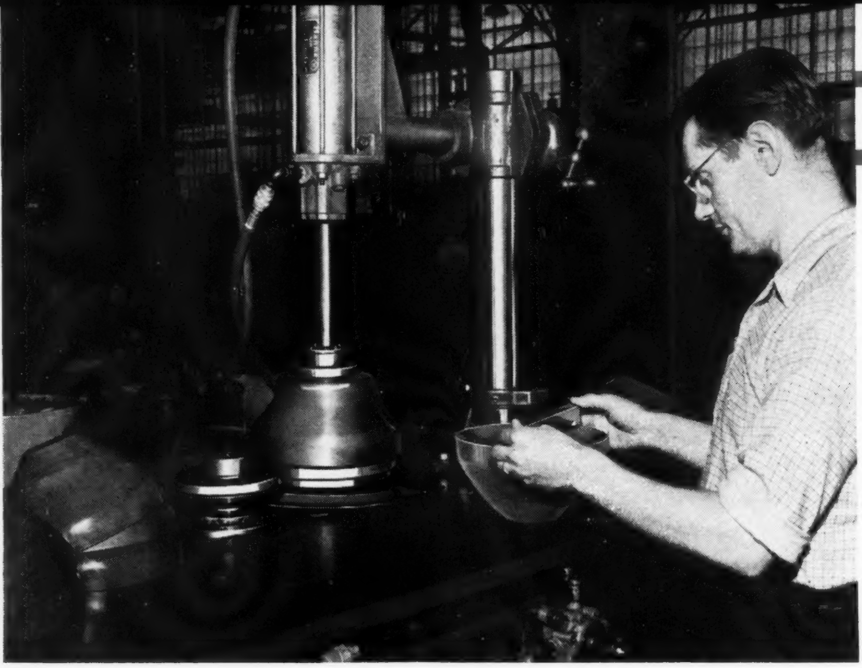


Fig. 10. A stamping trimmer is used extensively for trimming deep-drawn parts, such as the flame-tube scoop

sheet-metal components of the "Turbo-Wasp" engine. These are precision-stamped in the mechanical presses that are used for the accurate secondary operations performed on the deep-drawn parts. The flame-tube baffle is typical of these stampings. This is pierced, blanked, annealed, and formed, among other operations. The progressive die used for piercing, blanking, and trimming this Nimonic part is illustrated in Fig. 7.

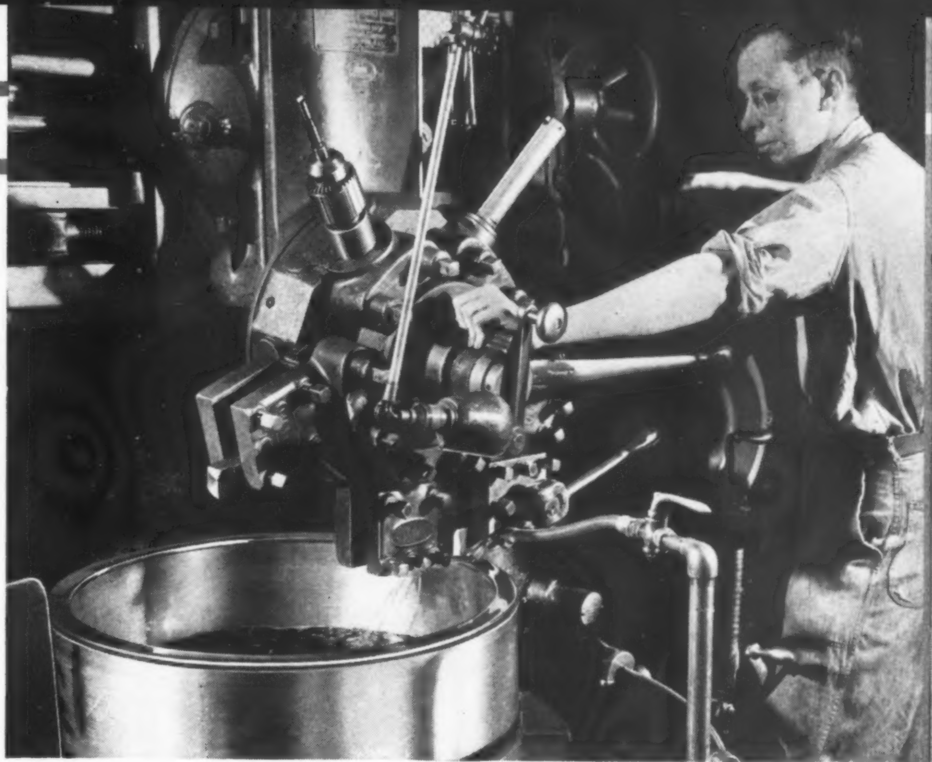
Although the mechanical presses are widely used for trimming drawn parts, many large parts are machined to avoid the need for costly compound dies or expensive press operations. The trimming method employed for any particular part depends largely upon the design of the part and the equipment available. A stamping trimmer, Fig. 10, is used extensively for trimming work such as the flame-tube scoop. The work-holding fixture and the cutting tool, which moves into the work under pressure, are built into this air-operated machine. Another means of trimming large parts is illustrated in Fig. 11; here a drawn aluminum toroidal vane is shown on a lathe trimming fixture.

Many other machining operations are required on individual parts before they are welded into assembled components of the engine. One of the most important of these is the forming of the edges of pierced holes to precise radii. This is done to prevent fatigue cracks being formed by vibration due to the high-velocity air flow. Carbide cutters and small, hard polishing wheels are used in machine and bench operations for this work. Other machining operations include the drilling of clearance holes in the inner cone of the exhaust unit. This is accomplished on a radial drilling machine, using a special jig which locates the work from a machined flange in the base of the cone. Vertical turret lathes are employed to machine exhaust-unit flanges from large stainless-steel castings, Fig. 12. Because

Fig. 11. Toroidal air-inlet vanes, employed to direct the flow of air to the compressor, are precisely trimmed in lathes

Fig. 12. (Right) Flanges for the combustion chamber are machined to close tolerances from stainless-steel castings

Fig. 13. (Below) Among the many parts made by rolling sheet metal is the exhaust-unit inner cone, which is formed accurately in this cone-roller



18-8 stainless steel is tough and hardens rapidly under cold-working, it is difficult to machine. Moderately deep cuts are taken with carbide tools, fed continuously to avoid glazing.

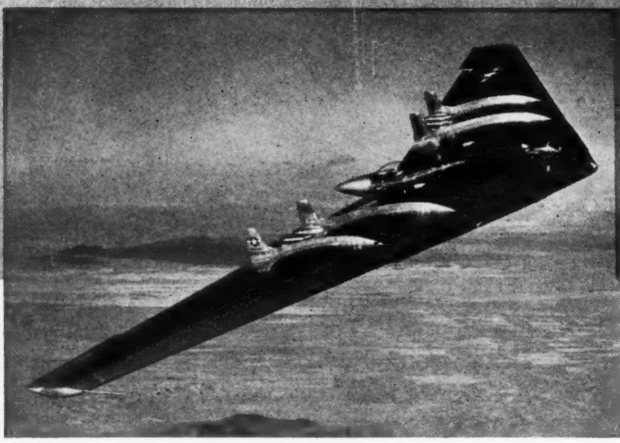
Power shears, brakes, and rolls, as well as nibblers, bench rolls, etc., are a few of the numerous metal cutting and forming machines employed for fabricating rolled sheet-metal components. The exhaust-unit inner cone is a typical rolled and welded part formed on a machine specifically designed for the purpose (Fig. 13). The conical rolls on this machine are interchangeable. By adjusting the setting of the machine and changing the rolls, the angle and size of the cone can be changed as necessary. Among other rolled and welded parts are the exhaust duct, which is made of 18-8 stainless-steel sheet, and the flame tube, or liner front, made of 0.048-inch Nimonic material.

Pressed, deep-drawn, and rolled parts are all used in conjunction with machined flanges, bosses, and miscellaneous fittings at assembly. To insure high quality of these parts, rigid control is exercised over stock procurement. Before release to production, all material is thoroughly inspected for chemical analysis, thickness, surface finish, hardness, physical structure, and general conformance to specifications.

Heat code symbols are placed on raw sheet stock, so that the material content of any particular part can be traced from the finished item back to the manufacturer's melt. In addition to heat code symbols, important castings and forgings are provided with individual serial numbers, which are specified on the order for identification purposes when a production run of engines is to be made.

The quality control procedures maintained over welding and the methods employed in joining stamped, deep-drawn, and rolled parts into sub-assemblies and assembled components of the JT-6 "Turbo-Wasp" engine will be described in a second article, to be published in a subsequent number of MACHINERY.

Precision Forging of Temperature-Resistant Jet-Engine Blades



Northrop YB-49 "Flying Wing" Jet Bomber

By C. H. SMITH, JR., President
The Steel Improvement & Forge Co.
Cleveland, Ohio

Techniques Employed in Forging Tough Alloys that Resist Deformation even at High Temperatures. Turbine Buckets and Rotor Blades are Forged to Precision Tolerances to Minimize Machining

WHILE the principle of the gas turbine is hundreds of years old, such power plants did not become commercially successful until alloys were developed capable of withstanding the heat, centrifugal forces, thermal stresses, corrosion, and vibration to which equipment of this type is subjected. The development of these alloys, however, introduced serious problems in the production of the complex-shaped parts required. How such problems have been solved in the forging of jet-engine blades at the Steel Improvement & Forge Co. is described in this article.

Blading for aircraft jet engines is made up of three different kinds of parts:

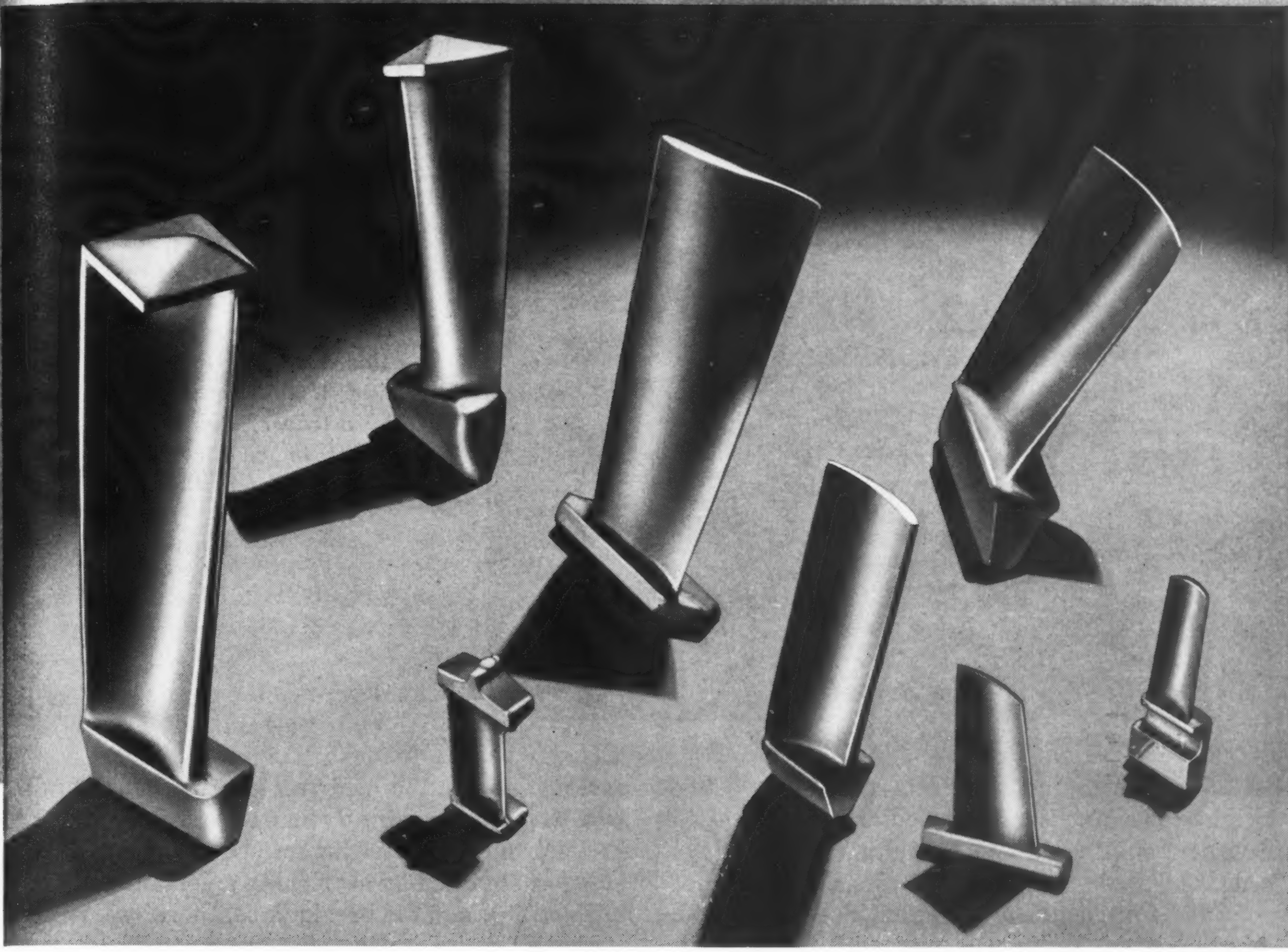
1. Rotor or compressor blades—rotating members that are secured to the rotor of the jet-engine compressor and are used to compress the air sucked into the engine.

2. Vanes—stationary members used to change the direction of flow of the air or combustion gases.

3. Turbine buckets, mounted around the periphery of the turbine rotor and rotated by the hot mixture of air and combustion gases.

These parts are manufactured by one of the following processes: (1) Forging—either rough forging, followed by considerable machining, or precision forging, requiring a minimum of finishing. (2) Casting by means of the investment or lost wax process, also requiring a minimum of finishing. (3) Machining from bar stock. (4) Forming from tubing. In this article, attention will be confined to forging techniques. Typical gas-turbine blades forged from various high-temperature alloys are shown in the heading illustration.

Stainless steel was the starting point in the



development of wrought alloys having good creep and rupture strength and corrosion and oxidation resistance at high temperatures. In fact, compressor blades, which operate in a comparatively cool section of the engine (at temperatures not exceeding 400 degrees F.), are forged from AISI 403 stainless steel. This steel contains a maximum of 0.15 per cent carbon and about 12.25 per cent chromium.

Turbine buckets, however, which must withstand centrifugal forces (due to their high rotational speeds) of about 25,000 pounds per square inch and temperatures as high as 1500 degrees F., required the development of higher strength, more heat-resistant alloys. The compositions of some of the alloys developed for use in forging turbine buckets are shown in the accompanying table.

These alloys were specifically designed to resist deformation at high temperatures, and are, therefore, most difficult to forge and machine. Forging and machining are further complicated by the shape of the blade to be produced. The cross-section of the blade is thin, trailing to almost a knife-like edge along one side. The thick root adjacent to the thin blade section introduces problems of warpage or cracking during heating and forging.

To reduce the amount of finishing required, techniques have been developed for precision forging of the blades to tolerances previously considered impractical. Specified blade thickness is maintained within $\pm$ 0.005 inch, and warp angle or twist tolerance is held to $\pm$ 1/2 degree, variation from true blade contour to $\pm$ 0.003 inch, and bow or deflection in the over-all length of the blade to $\pm$ 0.010 inch. In addition to the close tolerances held, which minimizes the machining subsequently required, precision forgings are metallurgically superior, and have better mechanical properties. Precision forgings cost about ten times more than rough forgings. However, machining costs, with rough forging, bring the ultimate cost very close to that of a precision forging.

Compressor blades for aircraft jet engines are precision forged in some cases, but the trend in their production is toward rough forging. Aside from the economic consideration, this trend is influenced by the greater ease with which the

Fig. 1. Die-sinking a die for forging blades. Movement of the cutting tool is controlled by a tracer (seen at the right) in contact with a master die

stainless steel from which these blades are made can be machined and finished and the closer tolerances obtainable by machining. Turbine buckets, however, are generally precision forged.

Dies for rough-forging the blades are made from standard die-block material. These chromium-nickel-molybdenum alloy steel blocks are heat-treated prior to machining by normalizing, quenching, and tempering to impart the maximum hardness (42 to 45 Rockwell C) that permits economical machining. Subsequent hardening is not required.

Blade dies for precision forging are of the insert type, with the die insert either shrunk or keyed into a body block. The body is made from the same material as the rough-forging dies, but the hardness is reduced to about 40 Rockwell C. Inserts are made from hot-work tool-steel containing 0.35 per cent carbon, 0.30 per cent manganese, 1.00 per cent silicon, 5.00 per cent chromium, 0.40 per cent vanadium, 1.25 per cent tungsten, and 1.50 per cent molybdenum. The inserts are solution heat-treated after machining to a hardness ranging from 51 to 55 Rockwell C. The hardness and wear resistance of such die steels is obtained by sacrificing a certain amount of ductility, and die breakage is, therefore, more common.

Impressions are sunk in the faces of the dies on large tracer-controlled Cincinnati Hydro-Tels, such as the one shown in Fig. 1. Die-sinking of precision forging dies requires extreme care, since an error of only $\pm$ 0.0015 inch will sacrifice half of the forging tolerance before the die is even placed in service. Templets for the master die are therefore made to exacting tolerances by comparing them with a drawing (made twenty times actual size) on a Jones & Lamson optical comparator. Lead casts are made and measured to check the die dimensions before forging.

Movement of the tracer finger over the surface of the master die, seen at the right in the illustration, is hydraulically relayed to the tool cutting the forging die, at the left. Roughing

High-Temperature-Resistant Alloys Used in

Alloy	Manufacturer	Composition, Per Cent					
		Carbon	Nickel	Chromium	Molybdenum	Tungsten	Cobalt
N-155	Haynes Stellite Co.*	0.10–0.20	18.0–22.0	18.0–22.0	2.5–3.5	1.5–2.5	18.0–22.0
N-153	Haynes Stellite Co.*	0.10–0.20	13.0–17.0	14.0–18.0	2.5–3.5	1.5–2.5	11.0–15.0
Hastelloy B	Haynes Stellite Co.*	0.02–0.12	62.5–68.5	....	26.0–30.0	......	....
S-816	Allegheny-Ludlum Steel Corporation	0.30–0.45	18.0–22.0	18.0–22.0	3.0–5.0	3.5–6.0	38.0 Min.
Inconel X	International Nickel Co.	0.08 Max.	71.0–75.0	14.0–16.0	....	......	....
16-25-6	Timken Roller Bearing Co.	0.12 Max.	24.0–27.0	15.0–17.5	5.5–7.0	......	....
Nimonic 80	International Nickel Co.	0.08 Max.	72.0–76.0	20.0–22.0	....	......	....

*Developed in conjunction with Union Carbide & Carbon Corporation.

JET-ENGINE BLADES

Fig. 2. Upset billets are reheated and forged to shape on this drop-hammer. These operations are performed in one die without reheating

ball type cutting tools are rotated at 190 R.P.M. and fed at the rate of 1 1/2 inches per minute, while finishing tools are revolved at 650 R.P.M. and fed 25 inches per minute. A cutting fluid cannot be used in the die-sinking operation because the view of the work and tool would be obstructed. Compressed air is used to cool the tool and blow the chips from the work. Portable pneumatic and electric grinding and polishing tools are employed for finishing the dies on workbenches.

Rough-forging dies produce about 3500 blades before resinking is necessary. These dies can be resunk five or six times before they are discarded. Precision forging dies, however, are normally discarded when the original sinking has worn beyond the allowable limits. Although such dies have produced as many as 1500 blades, their average life is from 300 to 400 blades. Precision forging dies cannot be allowed to wear a normal amount because of the close tolerance required on the parts.

Die wear is much more rapid when forging thin parts, such as buckets or blades, because there is less hot metal between upper and lower dies to cushion the blow of the hammer ram and protect the die. Also, a much more powerful blow is required to make such high-temperature alloys flow into the impressions of the die.

Rough-forging of jet-engine compressor blades follows, in general, conventional forging practices. Hot upsetting or fullering is employed to amass sufficient stock at one section of the cut-to-length bar, the surplus material being required to fill the blade root impression in the die. The bars are heated to approximately 2125 degrees F. before being inserted between the forging dies mounted in an Ajax 1 1/2-inch capacity upsetting machine.

The upset bars are reheated to approximately 2125 degrees F. before they are forged on drop-hammers ranging in size from 1500 to 3000 pounds. Three operations (edging, blocking, and finishing) are performed in one die, two blows of the hammer generally being required for each operation. In the edging impression of the forging die, the "ball" of material gathered in the upsetting operation and the remainder of the bar are flattened. In blocking, the flattened part is forged to produce a rough approximation of the shape of the part. The final forging operation is performed in the finishing impression of the die, Fig. 2, which imparts the desired shape to the metal.

Only one heating is required for the three forging operations performed in producing compressor blades. Excess metal, or flash, forced into the gutters surrounding the finishing impression of the rough-forging die is removed in a trimming press. The tolerance generally held on the thickness of rough-forged blades is — 0.000 + 0.050 inch above the machining allowance specified by the customer.

Rough-forged compressor blades, made from AISI 403 stainless steel, are normalized at from 1750 to 1800 degrees F. After cooling in air, the

d in Forging Turbine Buckets

	Composition, Per Cent					
alt	Columbium	Nitrogen	Iron	Vanadium	Titanium	Aluminum
22.0	0.75–1.25	0.10–0.20	Balance	....	....	......
15.0	0.75–1.25	0.10–0.20	Balance	....	....	......
...	....	....	Balance	0.25–0.50	....	......
Min.	2.5 –4.0	....	Balance	....	....	......
...	0.7 –1.2	....	Balance	....	2.25–2.75	0.4–1.0
...	....	0.10–0.20	Balance	....	....	......
...	....	....	Balance	....	2.25–2.75	0.4–1.0

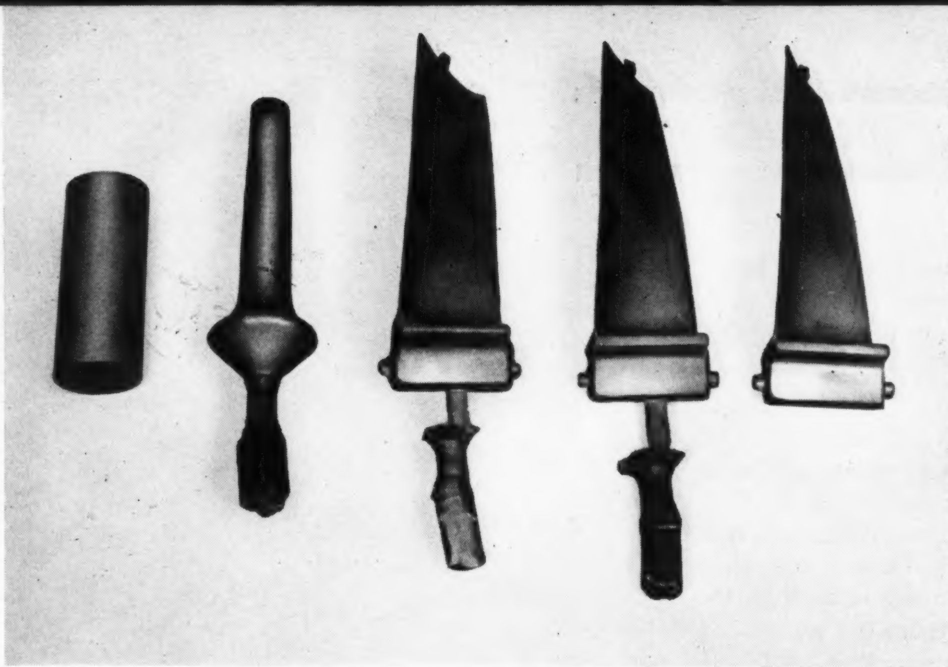


Fig. 3. Some of the successive shapes produced in forging the turbine bucket seen at the right from the 2 1/4-inch diameter bar at the left

blades are tempered at approximately 1020 degrees F., resulting in a hardness of from 30 to 38 Rockwell C.

Precision forging of turbine buckets requires many more operations than rough forging, including frequent reheating, and much more care. Relatively light hammer blows must be employed in the initial breakdown operations to prevent rupture. However, as the forging becomes flatter and thinner, heavier blows can be struck without danger of cracking the forging, since the force will be distributed over a larger area. On certain turbine buckets, the blade is so thin that only one blow can be made per heating.

Some of the shapes successively produced in the precision forging of a typical turbine bucket are seen in Fig. 3. For this particular part, a billet, 2 1/4 inches in diameter by 5 1/4 inches long, of Allegheny-Ludlum S-816 alloy is employed to produce a bucket approximately 3 1/2 inches wide by 10 inches long and 5/8 inch thick, tapering to 0.050 inch thick at its trailing edge.

A simplified forging drawing of a typical shrouded turbine bucket is shown in Fig. 4. A complete drawing of this part would contain ten cross-sectional views and additional plan views.

Billets are cut from carefully inspected centerless-ground bar stock by means of an abrasive circular sawing machine. Cut bars are heated to a temperature of 1900 to 2150 degrees F., depending upon the alloy used, in controlled-atmosphere electric furnaces. Controlled-atmosphere furnaces are necessary in order to keep scaling of the blade surfaces at a minimum. Also, some of the alloys employed are subject to intergranular corrosion, necessitating a slightly re-

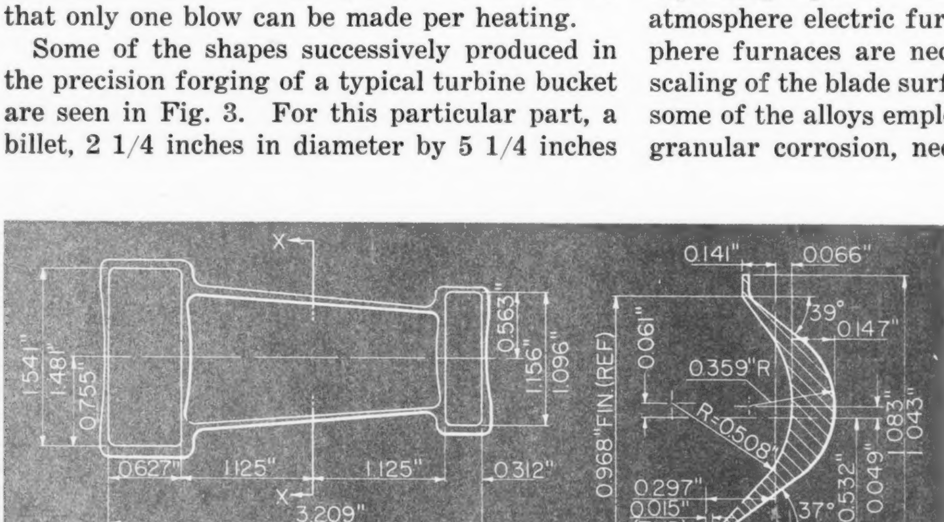


Fig. 4. Simplified forging drawing of a turbine bucket. A complete drawing of this part contains ten cross-sectional views

ducing atmosphere in the furnace. Other alloys require an oxidizing atmosphere to prevent carburization.

Hayes "Certain Curtain" furnaces are employed for this heating. The atmosphere is formed by burning a mixture of natural gas and air in a combustion chamber below the furnace. The products of combustion are forced upward through a slot across the furnace opening in sufficient volume to seal the throat against the entrance of air and to completely fill the furnace chamber around the work. Accurate recording pyrometers control the temperature to which the parts are heated within very close limits.

Rolling is the initial forging operation performed on precision buckets. This differs from upsetting in that the circular cross-section of the bar is reduced in diameter (except the portion that will form the root) and the over-all length is increased. The rolling die is mounted on a 2000-pound Erie steam hammer.

Any scale that might be formed on the bucket during rolling is removed in a subsequent blast-cleaning operation that employs steel shot as the abrasive. The rolled parts are loaded into a Pangborn Rotoblast barrel, where they are moved back and forth through a stream of steel shot thrown centrifugally from an overhead vaned rotor. The parts are then inspected visually, and any seams, cracks, folds, or other defects found in their surfaces are removed by grinding.

Surface-conditioned forgings are reheated to the same temperature as that employed for rolling, and flattened or blocked to rough shape, as seen at the center in Fig. 3. This particular bucket is blocked on a Chambersburg 2500-pound "Ceco-Drop" hammer, on which the ram is lifted by steam and dropped by gravity. This and the other hammers are each mounted on timbers set into a 30-ton block of concrete. The concrete inertia block rests on thirty-six springs attached to I-beams set in the block. The springs, supporting up to 60 tons total weight, absorb the vibrations of the forging operations. On such vibration-eliminating foundations, heavier hammers "bounce" almost 1/2 inch. The hammers employed for such work must be maintained in excellent condition, and it is essential that the dies be in perfect alignment.

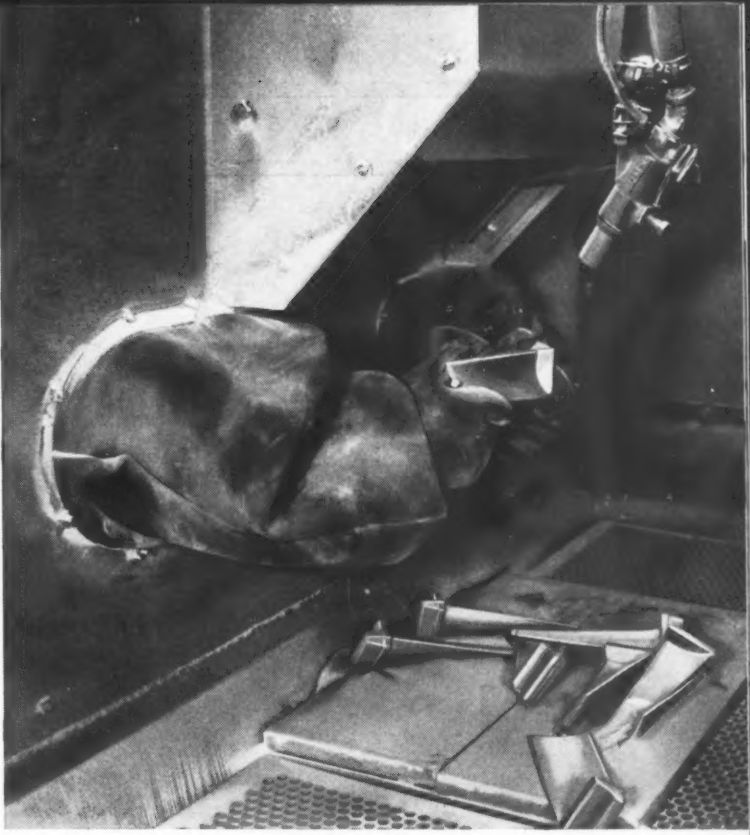


Fig. 5. Certain types of precision forged turbine buckets are sand-blasted to remove scale, improve the surface finish, and facilitate inspection. Other types are blasted with steel shot

Fig. 6. Rag wheels impregnated with aluminum-oxide abrasive grains, held by glue, are employed to polish the high-temperature alloy turbine buckets

Precision forging dies should be kept clean by wiping their surfaces between blows, and special die lubricants are required to prevent forgings from sticking in the dies. A graphite-base oil is applied to the forging dies periodically by means of a swab. Since an excess of lubricant is undesirable, the swab is merely kept moist, and not used dripping.

After blocking and removing the flash in a trimming press, it is again necessary to condition the surfaces of the buckets by shot-blasting and grinding. The parts are then reheated to the same temperature, and semi-finish forged. This forging operation is done in the single impression of the finishing die, but by controlling the number of ram blows, from 0.015 to 0.020 inch of excess stock is left on all surfaces of the bucket. Since the alloys employed for turbine buckets are expensive, the amount of flash at the parting line must be held to a minimum.

Trimmed semi-finished forgings are conditioned by blasting, grinding, and polishing. Either steel shot or silica sand is employed for blasting, depending upon the customer's specifications. A Pangborn rotary-table machine or cabinet, Fig. 5, is used for this blasting operation, since the tumbling action of the barrel machine would nick the surfaces of the buckets. After reheating the parts, they are finish-forged in the same die employed for semi-finishing, and again trimmed.

Precision forged buckets are then solution treated and age-hardened. Solution treatment is performed in a controlled-atmosphere, gas-fired furnace with the forgings placed in sealed boxes. The heating cycle varies with the alloy from one to two hours at 2150 degrees F., followed by an oil or water quench. Since the buckets are still soft, they can be straightened before age-hardening by hand bending or re-striking.

Age-hardening consists of holding the parts at a temperature of from 1300 to 1400 degrees F. for from twelve to twenty-four hours, followed by cooling in air. The resulting hardness ranges from 20 to 32 Rockwell C, the exact hardness depending upon the material. A Rockwell hardness test is made at two or three points on the surface of the forging.

Initial forgings in each production run are given a 100 per cent inspection by the final inspection department. Thereafter, forgings are sent to the inspection department at regular intervals to check their physical dimensions. Close coordination is necessary between the forge shop and inspection department to maintain accurate alignment of the forging dies in the hammer; to replace the dies when they have undergone the maximum allowable wear; and to minimize the production of scrap parts.

Completely forged and blasted blades are given a Magnaflux or Zyglo inspection, depending upon whether the alloy is magnetic or non-magnetic. In the former method, the forging is magnetized and covered with a solution of light oil in which is suspended small particles that become attracted to any defect in the forging.

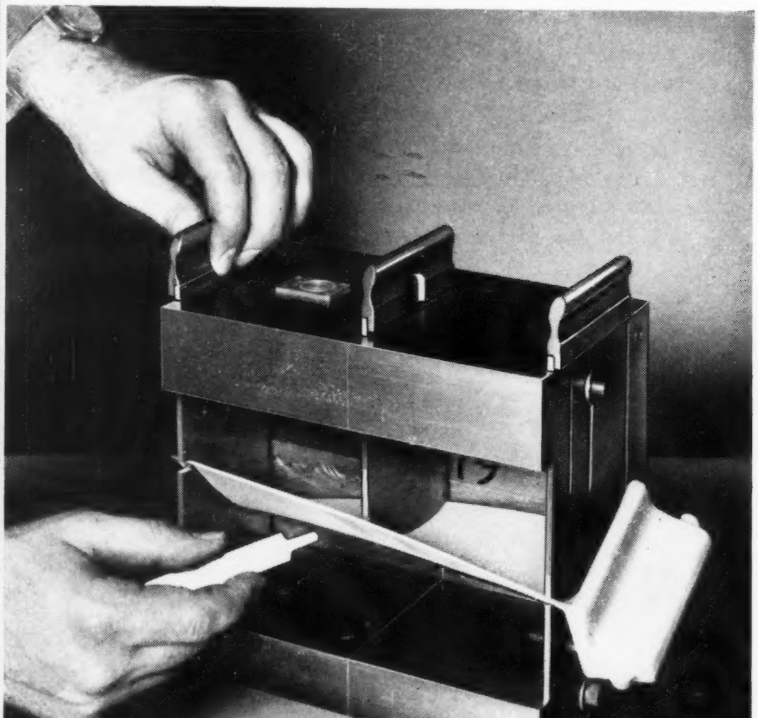


Fig. 7. "Guillotine" gages, equipped with vertical sliding templets, facilitate inspection of the blade contour, deflection, and degree of twist

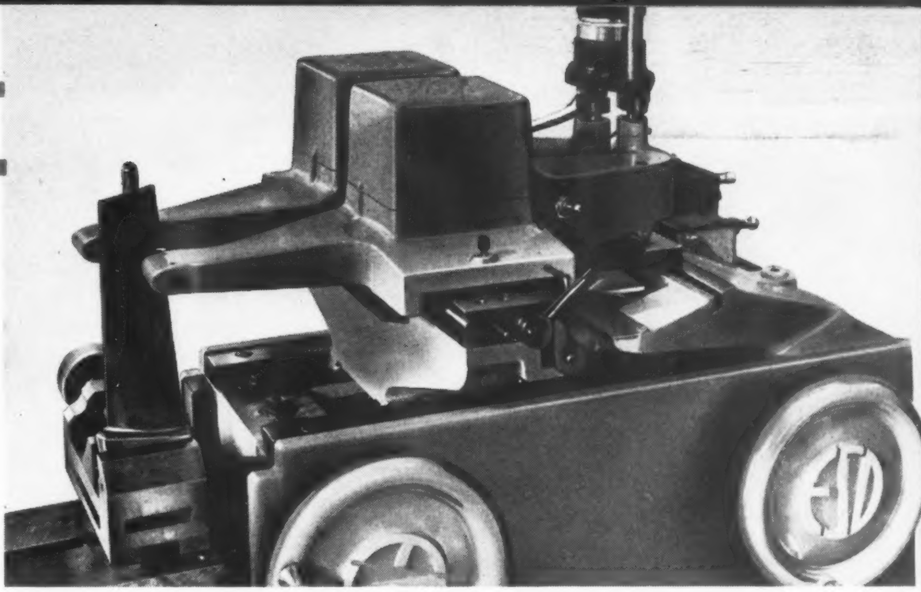


Fig. 8. Automatic blade inspection machine, in which permanent glass records can be made of the entire blade contour profile in various planes

With the latter method, a fluorescent penetrant is applied to the forging, which is subsequently inspected under "black light" to detect flaws.

Forgings passing either of these inspections are checked 100 per cent for dimensions and surface condition. Since precision forgings are placed in service without machining the blade surfaces, it is important that scale, pits, or other surface irregularities be eliminated. This is accomplished by blasting, polishing, and visual inspection. Careful inspection is extremely important because one defective blade can disastrously affect the balance of the gas turbine. Portable Chicago Pneumatic electric tools, mounted in bench vises and operating at 10,800 R.P.M. on 180-cycle current, are employed for polishing, as seen in Fig. 6. Glue is applied to the rag wheel, and the wheel is rolled in 220-grit aluminum-oxide abrasive in granular form. Pits in the surfaces of precision forgings must not be deeper than 0.003 inch, and some customers specify that there be no pits near the leading or trailing edge of the forging.

"Guillotine" gages, such as the one shown in Fig. 7, are employed to simultaneously check from two to five sections of an airfoil for variation from true contour, amount of bow or deflection (straightness tolerance), and degree of warp or twist. The gage consists essentially of a body in which are mounted from two to five vertical sliding templets. Each templet is finished, by means of an enlarged drawing and optical comparator, to the required contour for its particular location along the axis of the blade. With the forging in the "guillotine" gage, the templets are lowered and a feeler gage is employed to check the clearance between the surfaces of the part and the templets. The spacing between the top of the gage body and a scribed line on the side of the templet indicates the amount of bow or deflection of the forging at that section. Thickness of the blade is inspected by a micrometer or dial indicator set by means of gage-blocks.

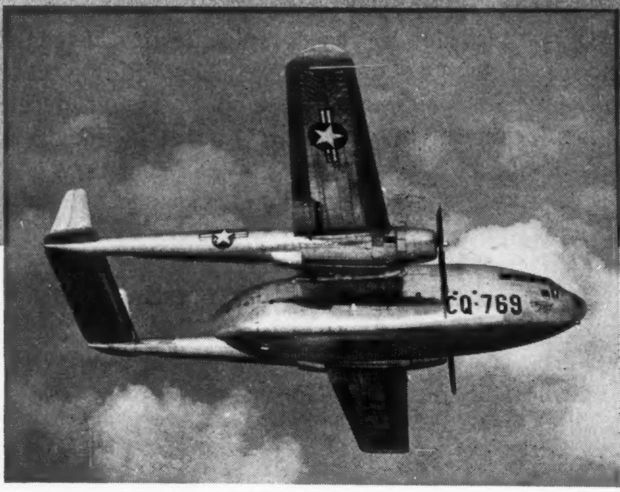
Permanent records of blade inspections can be made on the automatic inspection machine seen in Fig. 8. This "Pant-O-Scriber" blade checker, made by the Engineering Specialties Division of the Universal Engraving & Colorplate Co., is used to quickly inspect and measure the twist, thickness, displacement, warpage, and contour deviation of the blade.

The forging to be inspected is mounted vertically in the fixture seen at the left-hand end of the machine. The emulsion-coated glass plate that is scribed to produce the inspection record is inserted in a holding frame at the right. Two horizontal tracing-scribing arms are employed. At the left-hand end of each arm is attached a roller, and at the opposite end there is a motor-driven vertical scribing spindle. The handwheels are manipulated so that the rollers move across the surface of the blade in any desired plane. The scribing tools simultaneously duplicate these movements and produce an accurate record of the entire blade contour profile in this plane on the film-covered glass. Several contours can be scribed on the same record by moving the forging up or down.

After the record has been scribed on the glass plate, the plate is removed from the inspection machine and placed in a vertical lantern-slide projector. Here an accurate, full-size master profile drawing and the scribed record tracing are simultaneously projected on a screen, so that the blade profile can be easily checked. A vernier is provided for reading any movements necessary to align the scribed and master profile.

Building the Fairchild "Packet" by Advanced Tooling Methods

By ARTHUR D. JAIRETT
Chief Tool Engineer
Fairchild Aircraft Division
Fairchild Engine & Airplane Corp.
Hagerstown, Md.



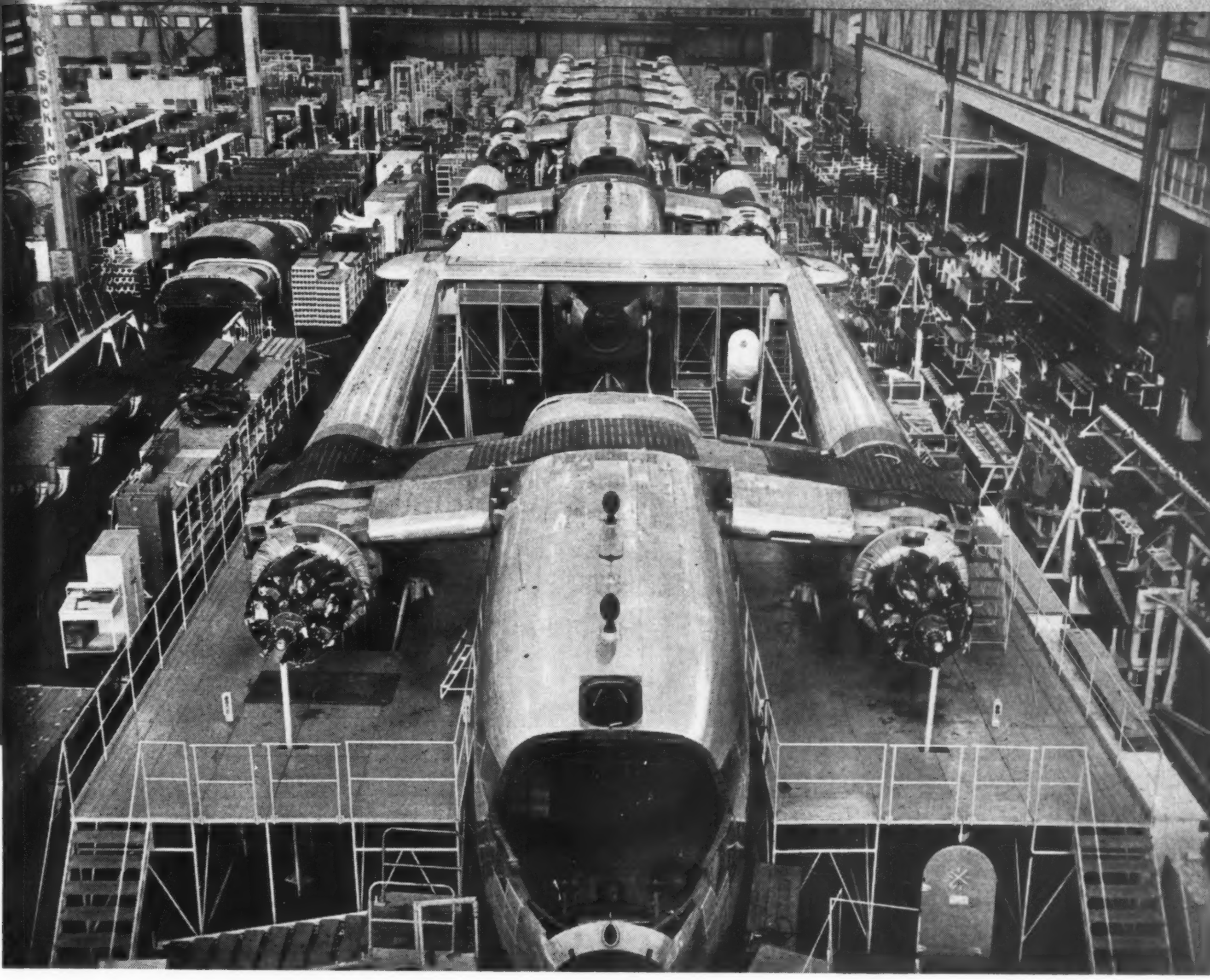
Fairchild C-119 "Packet" Troop and Cargo Transport

A Quick Change-Over to High-Volume Production of Aircraft is Made Possible by the Development and Use of Progressive Tooling Methods. Plastic Tooling, Universal Joggling Dies, the Milling of Forgings after Assembly, and Unique Assembly Fixtures are Some of the Latest Methods Adopted to Facilitate Industrial Preparedness

CHANGE-OVER to the production of C-119 aircraft—a new and larger version of the Packet twin-engine cargo or troop transport—has provided an excellent opportunity to incorporate plans for changing low-volume peacetime output into high production. Close cooperation between the engineering, tool engineering, production planning, and manufacturing departments has resulted in an airplane design adaptable to high-volume manufacture. New processes, tools, and fixtures have been developed, and manufacturing facilities have been arranged so that a quick change-over can be made to peak production.

Because of numerous design modifications in the new airplane, it was possible for the fuselage to be made in two sections instead of being built in one piece, as was the case previously. This and similar changes made possible reductions in the time required in major assembly jigs. The portable assembly jigs are mounted on tracks, permitting the jigs to be mated first and thus accurately mating the assembly.

For example, on the fuselage assembly conveyor line seen in the heading illustration, forward and aft sections of the fuselage are built up of bottoms, side panels, and top decks on alternate jigs moving along the line. Two adja-



cent jigs, each containing an accurately located half assembly of the fuselage, are then brought together by means of built-in dowels and bolts. Other assemblies (such as the nose section, wing, and tail boom), also mounted on portable jigs, converge on the fuselage assembly to complete the airplane as it progresses along the line.

A quarter section of the tail boom, approximately 28 feet long, is shown being riveted on an Erco riveter in Fig. 1. One operator can easily handle such large sections by means of the overhead conveyor and spring-pulley suspension arrangement, which allows the part to be rotated so that the surfaces to be riveted are normal to the ram of the machine. Such automatic machines have reduced hand riveting and welding to a minimum, and are about ten times as fast as hand riveters. About 99 per cent of the rivets pass inspection, compared with 10 to 15 per cent rejections with hand riveting.

Previous production practices required the machining of many forgings prior to their installation in various assemblies. Now rough forgings are installed in sub-assemblies, and the completed assemblies are then machined. Increased accuracy of the finished assembly is thus obtained, and the accuracy required in previous operations is less. Strains and stresses formerly induced by attempting to rivet and hold machined forgings to the necessary accuracy are avoided. Rejections and the need for reworking are reduced to a minimum, manpower and machine time are saved, costs are reduced, materials are conserved, and higher production rates are attained.

Specially designed machines are employed for this production technique. One such machine, seen in Fig. 2, is used to mill the right and left halves of the wing-panel center section. Corrugated stringers, wing "skin," "bath-tub" fittings, and the ends of the spar chords are all machined in one operation along the splice plane where the right and left halves of the center section are subsequently joined. Approximately 0.090 inch of stock is removed from the 24S-T aluminum-alloy parts with three passes of the milling

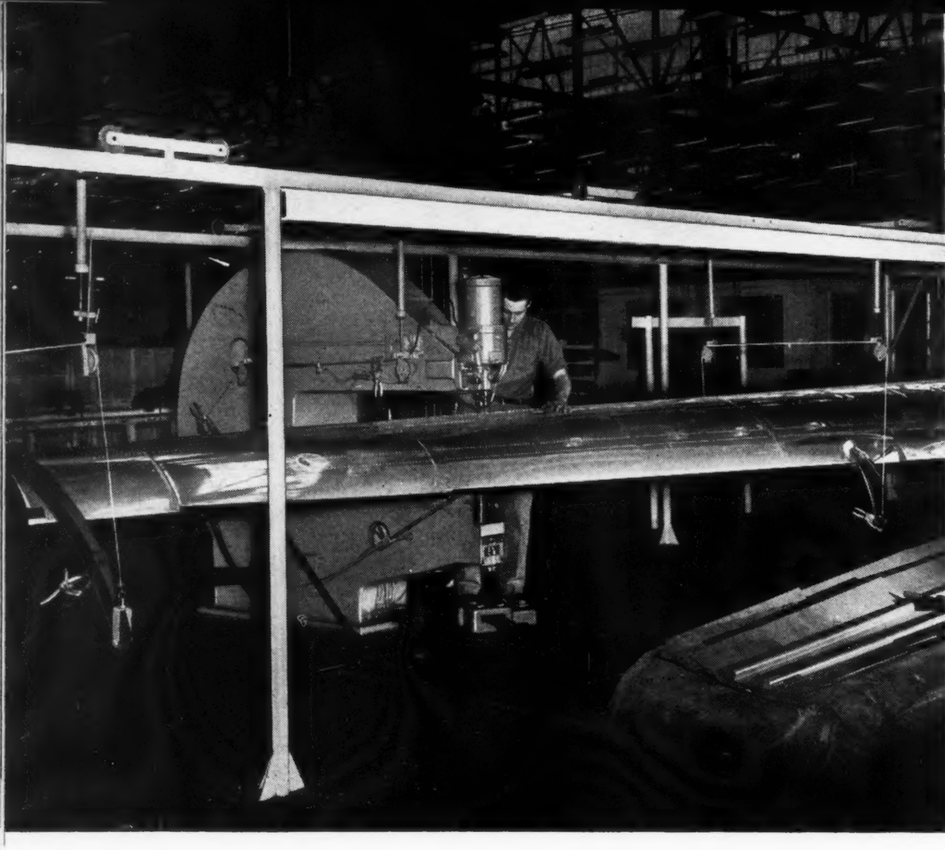


Fig. 1. Large parts, which are spring-suspended from an overhead roller conveyor, can be fed through an automatic riveting machine by one operator

cutter, 0.045 inch being removed in the first pass, 0.030 inch in the second, and 0.015 inch in the finish cut. Each wing-panel section is completely milled in five minutes. Joining surfaces of the mating sections are held to an accuracy of 0.002 inch.

The large wing sections are located in the special machine at four major points—two wing-hinge points and two fuselage attachment links. A clamping bar is mounted across the top of the wing section to provide rigidity. The machine consists essentially of a welded steel frame on which are mounted two horizontal guides (made from 4-inch diameter tubes), two vertical guides (made from 2-inch diameter bar stock), and a milling cutter head. Two vertical and two horizontal power-driven lead-screws are provided to move the cutter-head vertically and longitudinally.

The cutter-head is 4 inches in diameter, and contains two carbide-tipped blades that are rotated at 12,800 R.P.M. by a Chicago Pneumatic 180-cycle electric motor. A feed of 24 feet per minute is employed. The cutter-head is automatically traversed across the work, but it is raised or lowered manually to conform with the contour of the part being milled. Depth of cut is adjusted by means of a screw and graduated dial mounted on the cutter-head, and is limited by means of gage-blocks on the fixture.

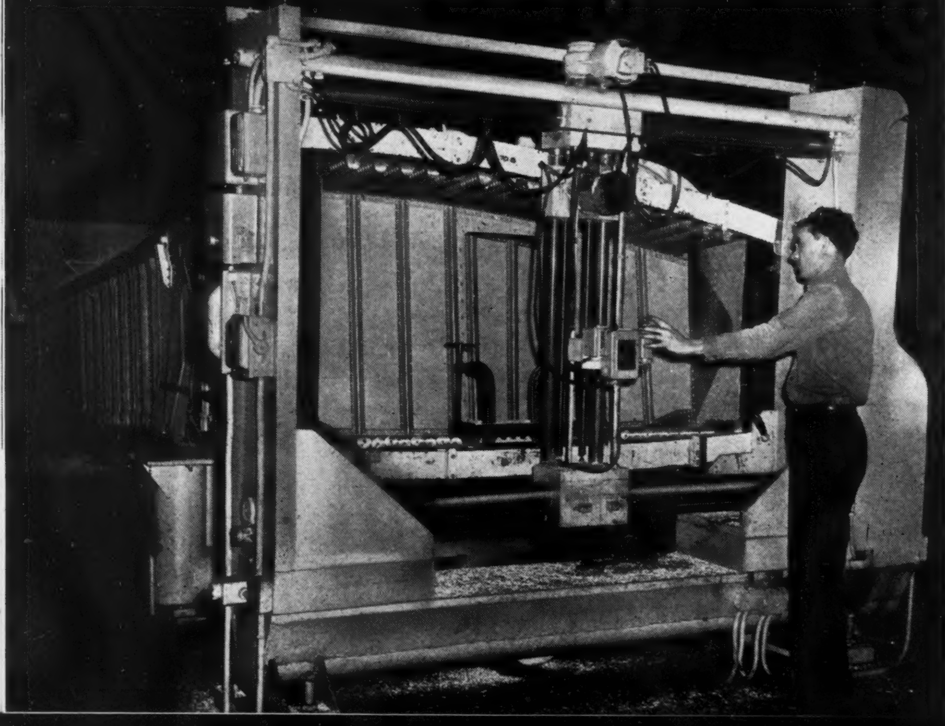


Fig. 2. The stringers, "skin," fittings, and ends of spar chords are machined on a special machine after being assembled into wing-panel sections

Another example of a special machine designed to mill an assembly is seen in Fig. 3. Here the tail-boom cone, of elliptical section, is milled on those surfaces that are subsequently attached to the tail boom proper. Approximately 0.090 inch of stock is removed from the aluminum-alloy channel-section frames, hat-section longitudinal stringers, stressed skin, and forged attachment fittings. The cone is located in the built-in fixture of the machine from the stabilizer and rudder-attachment points.

A two-bladed, carbide-tipped cutter-head, also rotated at 12,800 R.P.M. by a high-cycle electric motor, is eccentrically mounted on a cam-actuated arm. The two identical plate cams are rotated slowly by a gear-reduction motor to feed the cutter-head at the rate of 18 surface feet per minute. The plain bearings in which the cams rotate are free to pivot about pins mounted on the base of the machine. The cam-controlled automatic cycle requires about two minutes to completely machine the elliptical-shaped tail-boom cone. In this case also, depth of cut is controlled by gage-blocks mounted on the fixture.

Tube ends are reduced in diameter on a special hydraulically actuated swaging machine, Fig. 4, designed by Fairchild. Reductions in the diameter of the tubes are necessary to permit the fitting of control-tube terminals. The swaging operation is performed by forcing a die ring over the tube. A mandrel projects from the center of the die ring to size the bore of the tube and to prevent the wall from collapsing.

For large reductions, such as are required to obtain a 5/8-inch bore on the end of an aluminum-alloy tube 2 inches outside diameter by 0.049 inch wall thickness, it is necessary to reduce the diameter of the tube in successive steps. This is accomplished by mounting five die rings, each successive die having a smaller size bore, on a circular indexing type head. The sizing mandrel is employed only in the final operation, when the fifth die ring is forced over the tube to bring it to the required diameter.

Fig. 3. Tail-boom cone assemblies, of elliptical section, are automatically milled on a cam-controlled machine. About 0.090 inch of stock is removed in a two-minute cycle

Fig. 4. Hydraulically actuated swaging machine employed to reduce the diameter of tube ends. Four die rings are mounted on the circular indexing head

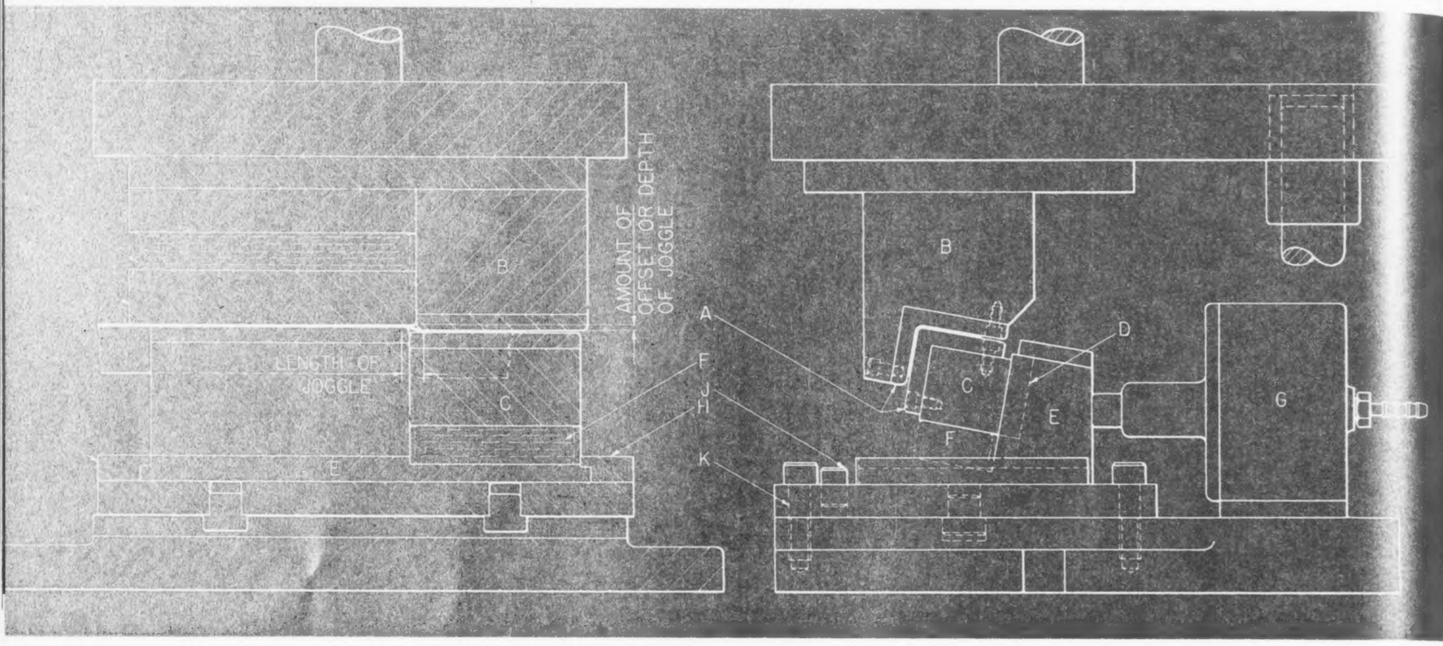


Fig. 5. Universal joggling die employing interchangeable inserts A, rubber pressure pads F and L, and air cylinder G. Depth of joggling can be varied without changing the inserts

A 24S-T aluminum-alloy tube having an outside diameter of 2 1/2 inches, a wall thickness of 0.065 inch, and an over-all length of 58 3/32 inches is shown being swaged in the illustration. The bore of the tube end is reduced to about 1 1/4 inches for a length of 7 inches by progressively using the four die rings seen mounted on the indexing head. The size of the tube end is held within ± 0.002 inch, and subsequent reaming is not required.

During swaging, the stationary tube is held securely near the end being formed by a split clamping block consisting of plywood bearing surfaces encased in a steel housing. The tube is prevented from sliding by a plate located against the opposite end of the tube. The hardened and ground tool-steel die rings have carefully rounded entries to their bores, similar in shape to the dies used for wire- or tube-drawing. For forming S A E 4130 steel tubes, the dies are made from S A E 52100 steel, and the ends of the tubes are copper-plated to facilitate swaging. Hydraulic pressures of approximately 4000 pounds per square inch are employed to force the die rings over the tubes.

The same machine can be employed to enlarge the ends of the tubes by driving a mandrel into the bore. In one such operation, the end of an S A E 4130 steel tube having an outside diameter of 2 inches and a wall thickness of 0.065 inch was expanded to an outside diameter of 2 3/16 inches. This method is also employed where the inside diameter of the tubes must be held to closer tolerances than that afforded by commercial tubing.

The ends of numerous formed frames, stringers, beams, and other sections employed in the airframe structure must be offset to permit them from overlapping adjoining members. Because of the many variations in cross-section of these structural shapes, the differences in thickness of the materials employed, and the amount of offset required, numerous dies are needed to perform the "joggling" operations. Tooling costs have been materially decreased by the design of universal joggling dies of the insert type. Each universal die can accommodate from twenty-five to thirty different pairs of inserts, and each insert can joggle from fifteen to twenty parts, depending upon the cross-sectional shape of the structural section.

Such a universal joggling die employed to off-

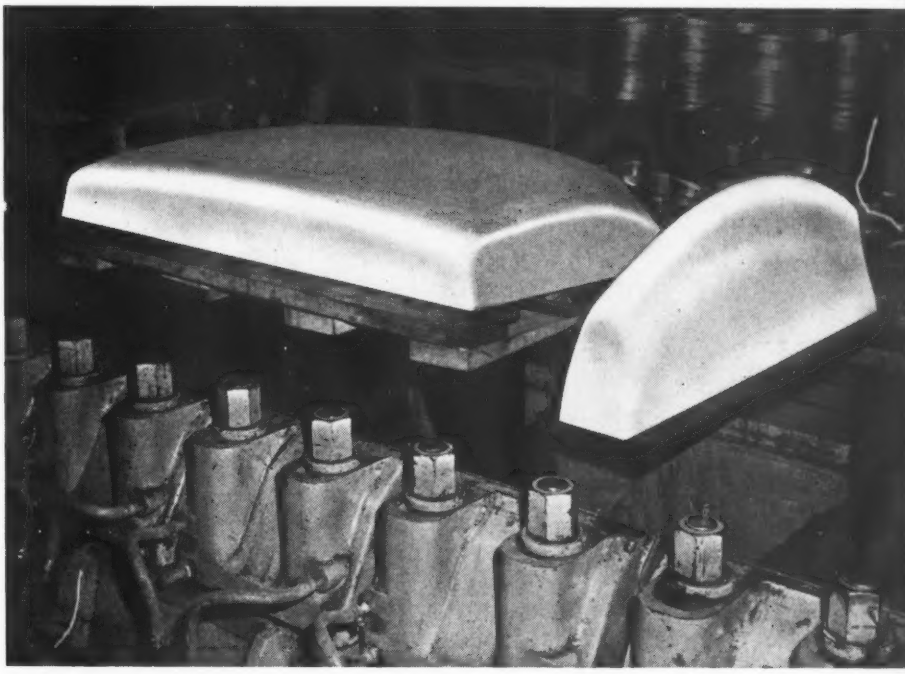


Fig. 6. Plastic blocks employed for stretch-forming aluminum-alloy sheets. Rudder tips, formed in one operation on the block at right, formerly required three operations

set both legs of a right-angle stringer is shown in Fig. 5. Interchangeable inserts *A* are bolted to punch *B* and die-block *C*. The inserts are machined from rough Meehanite castings. As punch *B* descends, die-block *C* is forced downward, guided by the dovetail slide *D* in cross-slide *E*. Rubber pressure pad *F* takes care of variations in the thickness of the material being joggled.

Sidewise motion of die-block *C*, to offset the other leg of the stringer, is simultaneously obtained by means of air cylinder *G*. The ram of

Fig. 7. Aluminum-alloy sheet, 0.020 inch in thickness, is stretch-formed into the skin for a cargo door of a Packet airplane over a plastic form block

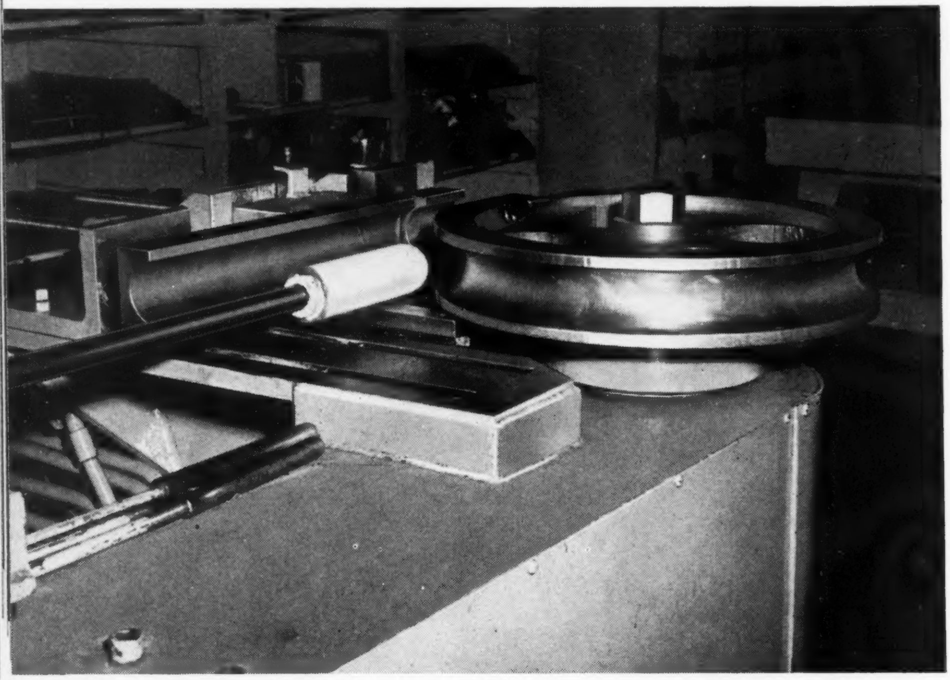


Fig. 8. Plastic tube-supporting mandrel, cast about a threaded steel insert, prevents wrinkling of aluminum tubes during bending

Fig. 9. Aluminum-alloy tubing, 2 1/2 inches in diameter, with a wall thickness of 0.049 inch, is bent to a radius of 10 inches, through an angle of 52 degrees, without wrinkling

the air cylinder is secured to cross-slide *E*, thus moving the cross-slide, die-block, and die insert toward and then away from the punch. Movement of the cross-slide is guided by gibs *H* and limited by stops *J*. The air cylinder can be moved forward or backward on the base of the die to accommodate various thicknesses of materials.

The combination of rubber pressure pads and air-actuated cross-slide gives great flexibility and accuracy. For the same type of structural section, depth of joggling or amount of offset can be varied from 0.032 to 3/8 inch without changing the inserts. Holes *K* are elongated to permit transverse adjustment of the cross-slide and die-block in order to vary the length of joggle. Another rubber pressure pad *L*, mounted above the clamping punch *M*, also permits variation in the thickness of the material being joggled.

Tooling costs have been reduced about 50 per cent on many forming operations by the use of plastic tools. Drawing dies, spinning chucks, blocks for stretch-forming, and tube-bending mandrels are some of the tools successfully made from plastic. "Catavar," a thermosetting plastic produced by the Catalin Corporation, is cast to the desired tool shape in plaster molds. Surface finish of the cast plastic tool depends upon the

condition of the mold. Generally the tool can be used in the "as cast" condition, without further processing. If the plaster mold is rough, however, the casting can be sanded to a smooth surface finish.

Two of the many plastic form blocks employed are seen in Fig. 6, mounted on the table of an Erco sheet-metal stretching machine. The sharp-nosed, deep block at the right is employed to stretch-form the leading edge of an aircraft rudder tip in one operation. With previous methods, it was necessary to form this part in three progressive operations. Skin for the rear cargo door of the Packet plane is shown being stretch-formed over the larger plastic block in Fig. 7. The skin is formed from 24S-O Alclad aluminum-alloy sheet, 0.020 inch thick. Light lubricating oil is brushed on the top surface of the plastic form block before clamping the sheet between the air-operated jaws of the machine for the stretching operation.

Plastic material can usually be employed for any forming tool where the plastic is confined by the metal being formed. It is not, however, applicable to heated dies required for forming magnesium, since the plastic will expand and crack when subjected to high temperatures. Also, it is not satisfactory for applications where shock loads are encountered, as, for example, in dies employed on drop-hammers.

Plastic drawing dies have proved unusually satisfactory. Parts deep-drawn in such dies have shown no appreciable reduction in metal thickness due to stretching. Less resistance is offered to the flow of the metal than is the case with steel dies, and a good surface finish is produced on the drawn part. More than 2000 elevator ribs, 3 feet long, have been drawn in one plastic die without any changes in dimensions of the die or drawn part. Plastic dies that have served their purpose can be used as filler in the manufacture of new dies.

Another excellent example of the use of plastic tooling is in tube bending. In the application illustrated in Fig. 8, plastic is employed as the tube-supporting mandrel, the plastic being cast about a threaded steel insert. This particular mandrel is used for forming oil-lines from 24S-O aluminum-alloy tubing having an outside diameter of 2 1/2 inches and a wall thickness of 0.049 inch. The oil-line is bent to a radius of 10 inches, through an angle of 52 degrees, on a Wallace hydraulic tube-bending machine, Fig. 9. This operation could not be performed successfully with a steel mandrel because of excessive wrinkling and scratching of the tube surfaces.

Pneumatic Self-Starter Developed for Aircraft Turbine Engines

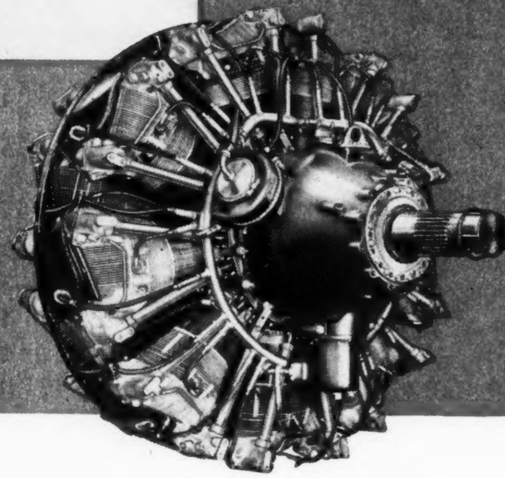
A SELF-CONTAINED, self-starting system for turbo-jet and turbo-prop aircraft engines has been developed by the AiResearch Mfg. Co., in conjunction with the Navy Bureau of Aeronautics. The system comprises a power source for providing compressed air and an air-operated starter. The complete unit offers a 20 per cent reduction in weight and a 75 per cent increase in power output, as compared with present starting systems.

The self-contained power unit of the starting system is, itself, a small turbo-jet, using the regular fuel supply of the airplane. Air entering this power unit passes through a two-stage centrifugal compressor and then to the starter, which is mounted directly on the turbine engine of the airplane. Some of the compressed air is diverted through two combustion chambers—one on each side of the miniature turbine—and back into the power unit.

A 3/4-H.P. electric motor energizes the starter unit, rotating it at about 6000 R.P.M. The starter unit is accelerated to 40,000 R.P.M. by the compressed air from the power unit. High-pressure air then energizes the air-turbine starter, developing about 35 H.P. to rotate the turbine engine on the aircraft at about one-third of its rated speed. Once the engine has been started, the high-pressure air can be diverted to air-operated accessories on the airplane.

Producin
with

Douglas AD-2 "Skyraider" Fighter



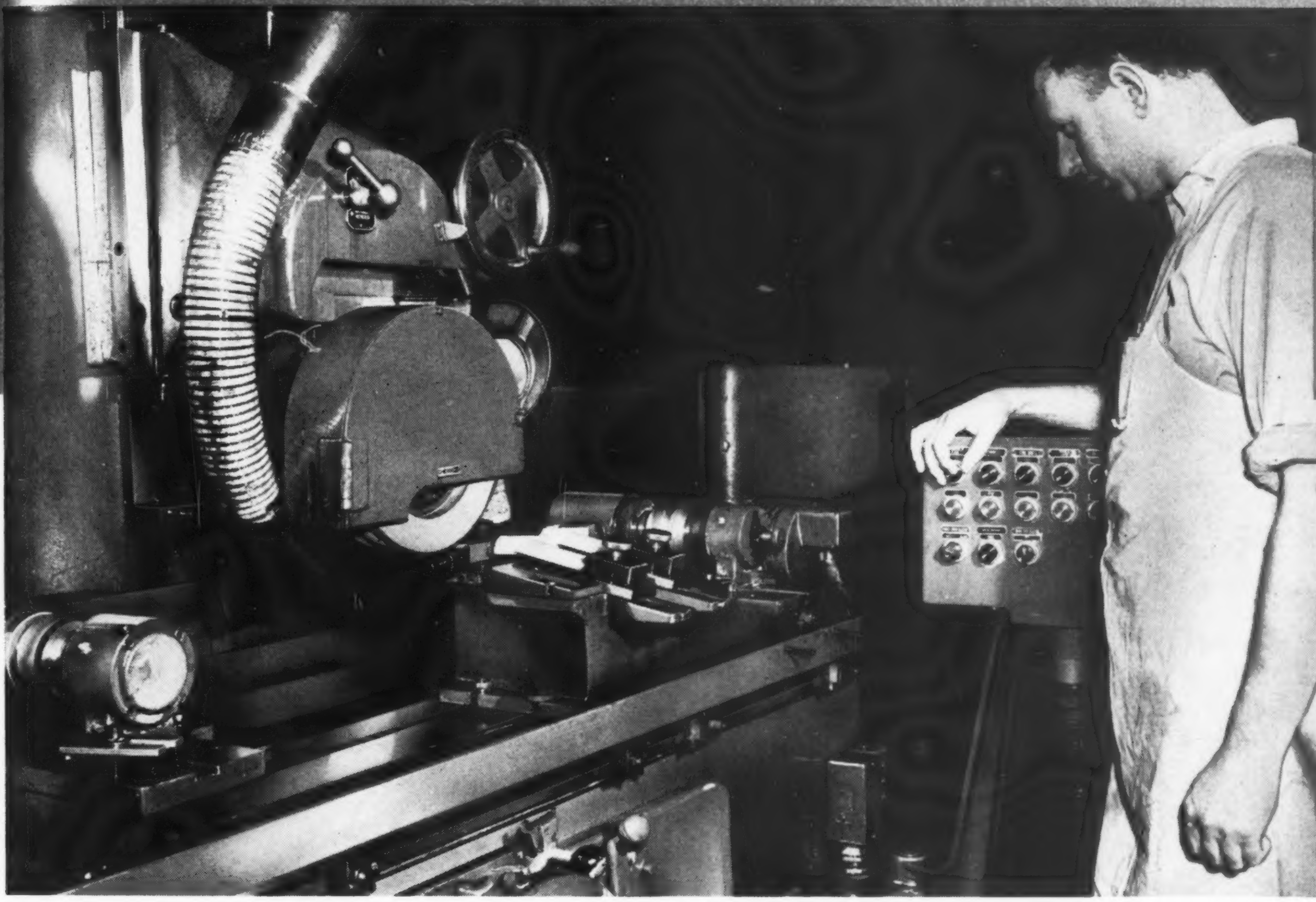
THE many parts that make up the "Cyclone" piston engines and "Typhoon" turbo-prop jet engines must be precisely made and thoroughly inspected to meet the high performance specifications required for the efficient flight of modern aircraft. Typical examples of the production equipment and methods used in producing some of these parts at the plant of the Wright Aeronautical Corporation, Wood-Ridge, N. J., are described in this article and in a second installment, to be published in a coming number of MACHINERY.

The recently developed "Typhoon," which combines the thrust obtained by jet propulsion with that gained by a propeller to produce great power, presents manufacturing problems that are somewhat different from those met in producing the piston engines. The large amount of welded sheet-metal components that make up some of the main sections of this engine is one of the reasons for this difference. One of the most difficult problems in the fabrication of sheet-metal assemblies, due to the lack of rigidity of these structures, is the maintenance of concentricity during machining operations.

The compressor front housing of the "Typhoon," made of stainless-steel sheet, is typical of the welded structures in which concentricity must be maintained. Fig. 1 shows the center diaphragm of this housing being machined on a 72-inch Bullard vertical turret lathe. The operation consists of boring a 24-inch support hole and back-facing a 27-inch flange. Concentricity must be held within 0.002 to 0.004 inch total indicator reading. To accomplish this, the housing is located on an aluminum adapter by means of eighteen pins that engage holes in the rear flange. By positioning the structure on these pins, the roundness of form essential to concentricity is achieved. After the machining operation, a checking ring is placed on three pins at the top of the housing to provide a surface against which a dial indicator can be applied for checking the concentricity.

The precise balancing of the rotating members of this engine is also of great importance. One of the impellers of the two-stage centrifugal flow compressor used may be seen on a dynamic balancer in Fig. 2. After rough-machining this part, it is placed on the balancer and rotated at 300 R.P.M. to determine the points at which it is out of balance and the extent of this condition. Putty is used to mark these locations, and the different weights of the putty wads indicate the degree of unbalance at each point. The impellers are then corrected by machining in accordance with the results of this test, and rotated at 7600 to 8000 R.P.M. for one minute, after which they

Wright Piston and Jet Engines
High-Production Equipment



are finish-machined and replaced in the balancing machine for the final balancing test.

Parts of other jet engines produced in this plant are quickly made in small quantities for experimental or special purposes. One such part is shown in Fig. 3. Here the dowel alignment holes in the flanges of the compressor housing for the 24-C jet engine are being bored on a Pratt & Whitney jig borer. These holes must be accurately located, since they provide the means of aligning the mating halves of the housing. By jig-boring this part, hole locations are easily held to plus or minus 0.001 inch without building special jigs.

Another interesting operation on jet-engine parts is the crush-grinding of the bases of turbine blades. Two blades may be seen on the table of a Thompson surface grinder in the heading illustration. Three grooves on each side of the bases form a fir-tree pattern that mates with a similar form in the turbine wheel to provide a means of locking the blades when they are assembled in the engine.

The first step in the operation consists of rough-grinding a tapered form on both sides of the base, after which the taper is finish-ground to size. A semi-finish and a finish grinding operation are then employed to "crush" the fir-tree pattern into the tapered sides. This form is maintained on the grinding wheel by means of a

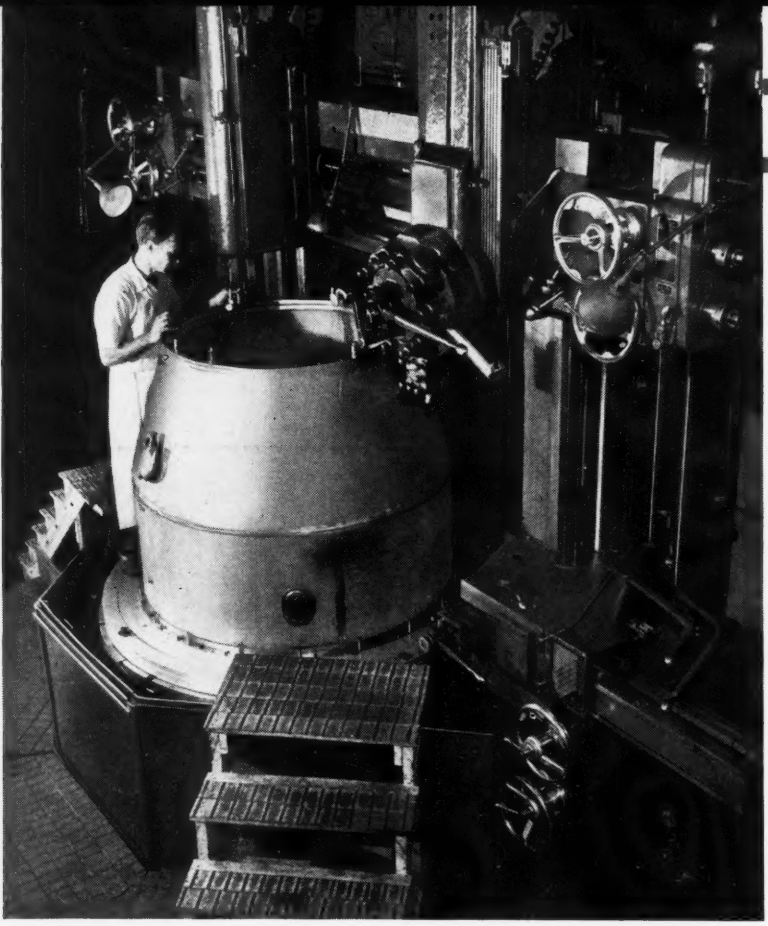


Fig. 1. Concentricity is maintained in machining the compressor front housing for the "Typhoon" turbo-prop jet engine by means of a special fixture

crush roller, which reproduces the form as the wheel wears. A master crusher is employed to form the wheel for re-grinding the crush roller when the latter wears. The size of the form on the blades is held to plus or minus 0.001 inch, measured over wires, and the contour is checked by means of an optical comparator.

The eighteen-cylinder "Cyclone," built to power such aircraft as the four-engine Boeing B-29 "Superfortress," the Martin "Mars" bomber, the Douglas "Skyraider," and others, offers production problems as interesting as those met in producing jet engines. The machining operations performed on such components as the crankcase, the cylinder heads, and the intake and exhaust cams are typical of the means employed for the production of high quality parts throughout this engine.

The foundation of the "Cyclone" engine is the crankcase, which serves to transmit the thrust from the propeller to the aircraft structure in which the engine is mounted. Among the principal parts that make up the crankcase are the supercharger front and rear housings and rear cover, the front, center, and rear main sections, and the front section. In order to withstand the great pressures developed by this powerful engine, the three main sections are made from chromium-nickel-molybdenum steel forgings.

Two rough-machining operations are performed on these forgings, one of which may be

Fig. 2. An impeller for the two-stage centrifugal flow compressor used in the "Typhoon" engine is balanced on the machine shown in this illustration

Fig. 3. Boring dowel alignment holes in the flange of the compressor housing for a jet engine on a jig-boring machine. The locations of the holes are maintained within plus or minus 0.001 inch

seen in Fig. 4. Here the center main section is shown being machined in a Foster "Fastermatic" automatic chucking machine. The work is centralized at the inside wall of its legs on an air chuck, which also clamps the outside diameter by means of the chuck jaws. Employing a spindle speed of 9 R.P.M., several cuts are made simultaneously at one end of the piece with high-speed steel tools. The tools are automatically fed to the work by a hydraulically operated arrangement which provides an independent feed for each face of the turret. An adjustable cam controls these feeds, so that each tool is presented to the work at the most efficient feed possible.

This operation consists of the simultaneous machining of an angular recess around the center of the outer periphery of the part, together with two blending radii. At the same time, the legs are faced and bored, a center hub is bored and its outside diameter turned, a web and the back of the legs are faced, and spherical radii are machined in the inner and outer periphery of the section to form a barrel shape. Turned surfaces are held to plus or minus 0.003 inch, and the tolerance on the hub bore size is plus or minus 0.001 inch. This series of operations requires less than eighty minutes for each piece.

Upon the completion of these cuts, some of which produce chips over 1 inch wide and 0.015 inch thick, the work is placed on a similar machine for performing the same operations on the opposite end. In this case, however, the work is located from the rough-machined bore to maintain concentricity.

For short-run production of replacement parts, other machines are used, in order not to disturb the high-quantity production set-ups. For example, when limited runs of crankcase

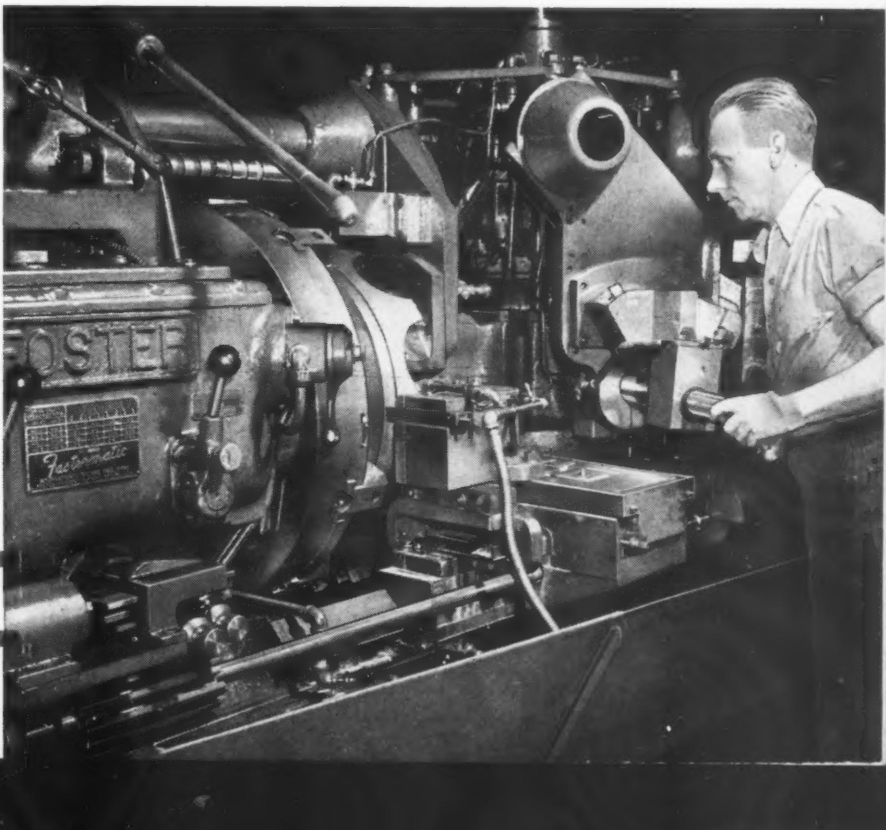


Fig. 4. Ten rough-machining cuts are taken at one time on forged center main sections of the "Cyclone" crankcase in an automatic chucking machine

parts are to be made, a Bullard vertical turret lathe is used for the same machining operations as are performed on the chucking machine, although the cuts are not made simultaneously. High-speed steel tool bits are also used on this machine, with approximately the same feeds and speeds.

After two rough-machining operations and two finishing operations, these crankcase sections are burred to remove all sharp edges. Tool marks are also removed, since such small flaws tend to produce cracks under the vibration encountered in operation. To insure the elimination of tool marks, the sections, which have a Brinell hardness of 241 to 285 as forged, are ground all over.

The spherical contour of the three main sections of the crankcase presents an interesting grinding problem. The operation is accomplished on an Arter surface grinder with a straight cup type wheel having a beveled face. The work is centered on a magnetic chuck and rotates in a horizontal plane. The chuck is adjusted to align the center of the spherical surface of the crankcase section with the grinding wheel. Rotating in a vertical plane, the wheel edge contacts the work to grind the spherical surface to a precise radius.

Another important operation is the grinding of a bearing retainer at the hub bore of the center main section. About 0.0095 inch of stock is removed from each side of the bore, as well as from the two end faces. The ground bore is held to plus or minus 0.001 inch in this operation, which is done in a Bryant chucking grinder.

This ground bore and a locating hole are used to position the crankcase center main sections for machining 102 assembly holes concentrically with the bearing. Nine holes are machined at one time on the Natco "Holesteel" multiple-spindle drilling machine illustrated in Fig. 5. The work is held in an indexing fixture on the work carriage for drilling the holes to 0.421 inch in diameter, finish-reaming to 0.4375 inch in diameter plus or minus 0.0005 inch, and countersinking to a 90-degree included angle 0.510 inch in diameter.

High-speed steel tools are guided through bushings in the upper side of the fixture. After the completion of the operation, the drill head is withdrawn and the fixture turned over, permitting the finished work to be removed and a new piece clamped in place. By locating mating parts in the same position in the fixture, hole alignment is insured when assembling the center sections to the front and rear sections, which are also machined in this manner. Hole locations are held to within plus or minus 0.0005 inch, and one part is completely drilled, reamed, and countersunk in approximately eleven minutes.

Other operations on the crankcase main sections include grinding the ends of the legs flat within a tolerance of 0.0005 inch in a vertical surface grinder. Following this operation, the parts are inspected and lapped. Lapping of these surfaces to a high degree of flatness is essential in order to obtain a tight joint at assembly, since these are the mating surfaces of the main sections of the assembled crankcase.

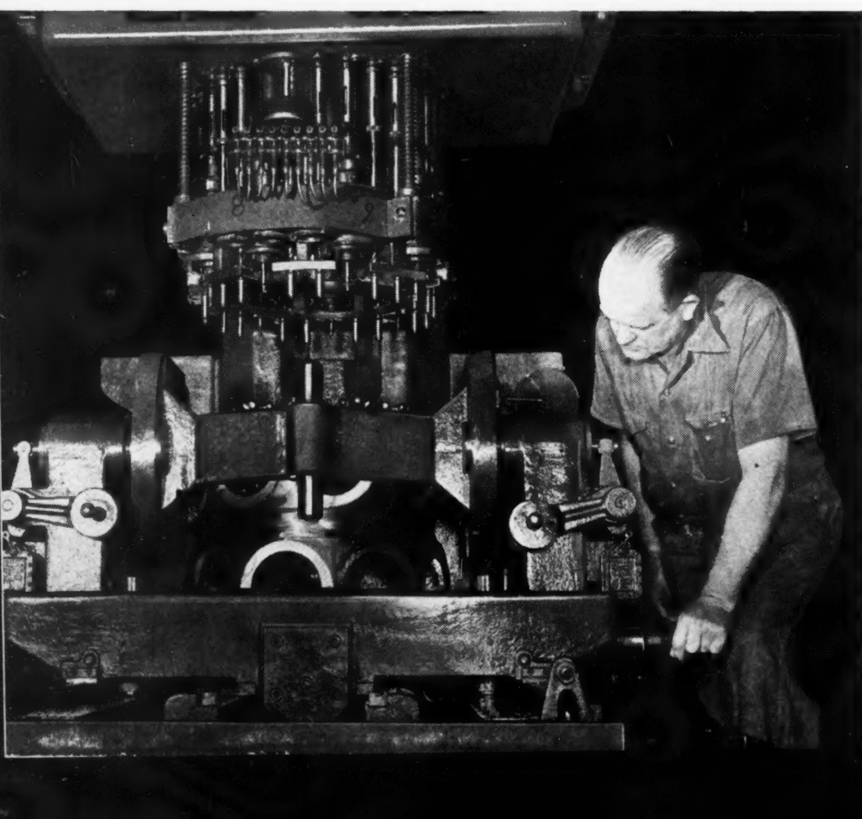


Fig. 5. Assembly holes in the crankcase section are simultaneously drilled, finish-reamed, and countersunk in the multiple-spindle drilling machine illustrated

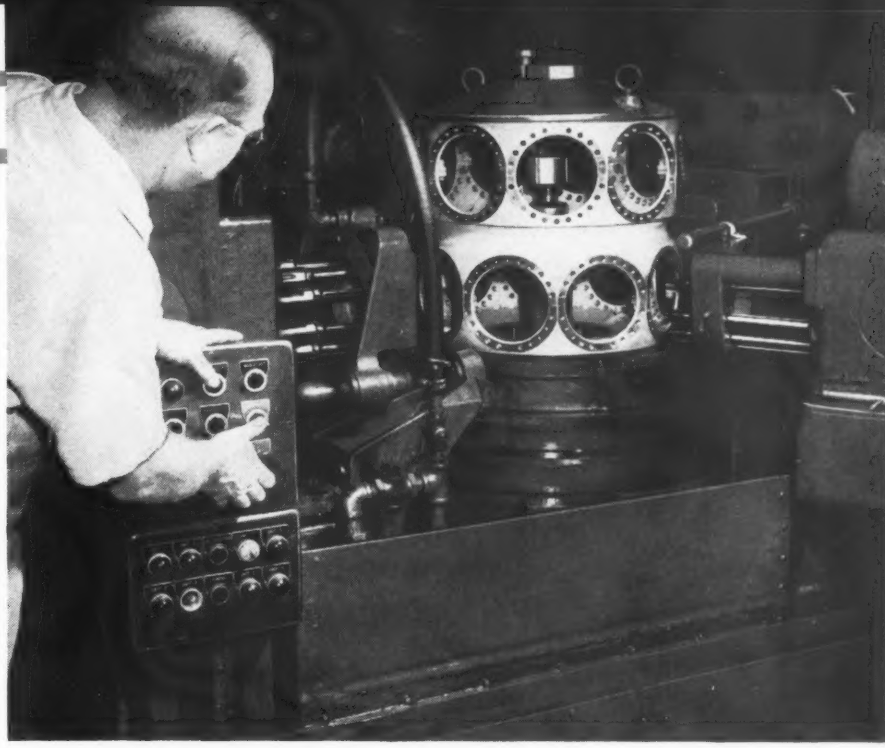


Fig. 6. Cylinder mounting pads on the crankcase main center sections are reamed, countersunk, and tapped in a four-way automatic indexing machine

One of the high-production operations on these crankcase parts is the machining of assembly holes in the cylinder mounting pads. Back-counterboring and tap-drilling twenty holes in each pad is done in a Greenlee six-station, horizontal, seven-way, automatic indexing machine.

The first and fourth heads operate alone when the machine is started, each drilling ten holes, 0.368 inch in diameter, in two of the pads in the first bank of nine cylinder ports. When this is accomplished, the machine table indexes and the second and fifth stations operate also, each back-counterboring five holes, 0.470 inch in diameter. After the second indexing, the third and sixth heads come into use, each also back-counterboring five holes.

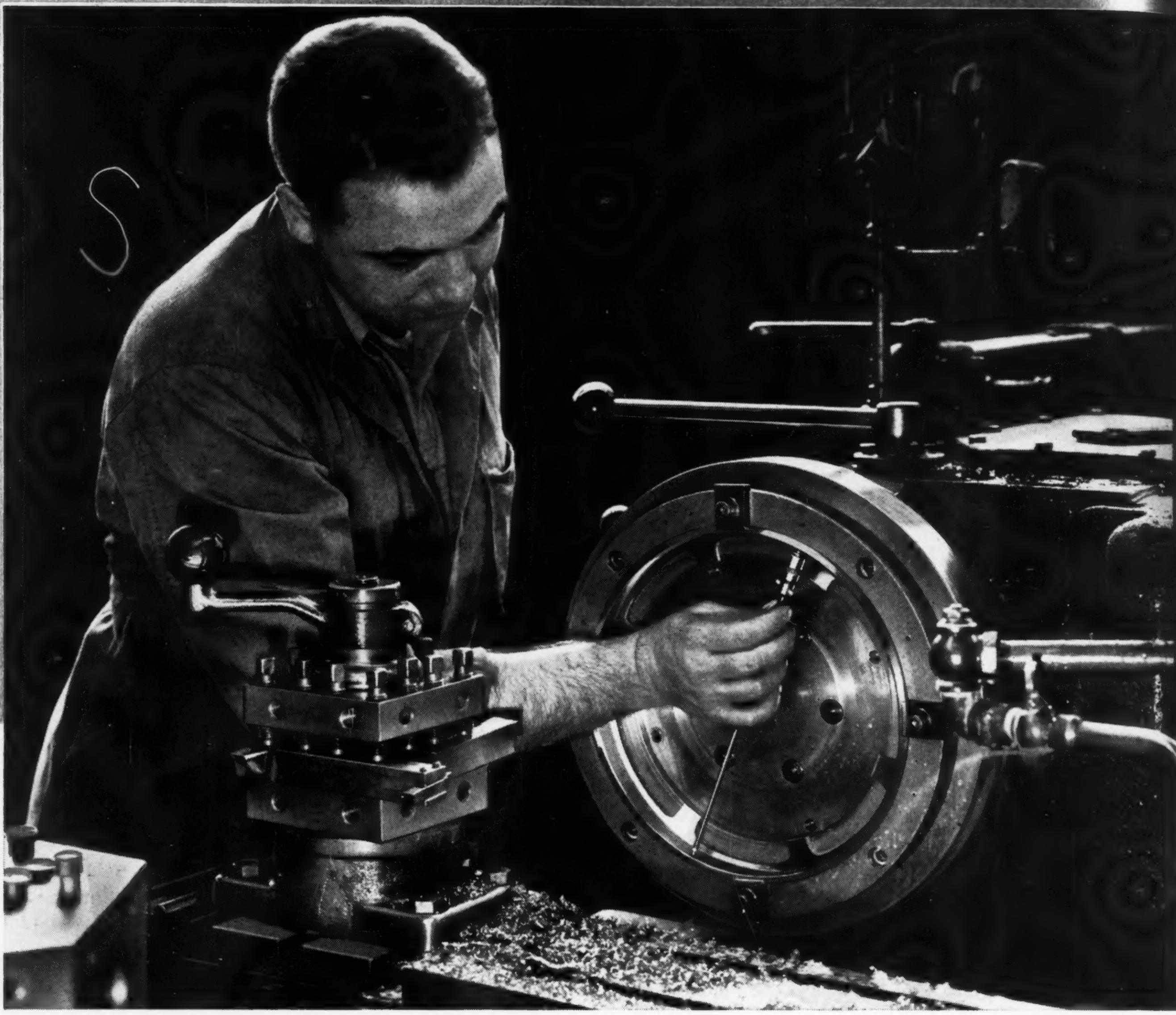
The back-counterboring tools are mounted in sliding holders, being located sufficiently off center to permit them to pass through the holes produced by the drilling heads. After the counterboring heads are fully advanced, the tools move transversely to a central position before beginning to rotate. The heads then feed backward to the proper depth of counterbore, after which the tools again move transversely for withdrawal.

When the cycle is complete, and each of the pads in one bank has had twenty holes drilled and counterbored in it, the crankcase section is turned over and the operation repeated on the second bank of cylinder pads. Approximately fifteen minutes is required to tap-drill and back-counterbore each bank of pads.

After an inspection procedure, the crankcase main sections are cadmium-plated and then subjected to a Magnaflux inspection for flaws, cracks, etc. They are then reassembled for machining the cylinder assembly holes. A Greenlee four-way, horizontal, seven-station, automatic indexing machine, especially built for the purpose, is used to perform combination reaming, countersinking, and tapping operations on these holes, as shown in Fig. 6.

In this case, the first and third heads operate when the machine is started. Each of these heads, which are actuated hydraulically, ream the 0.368-inch diameter drilled holes in the pads to 0.395 inch, plus or minus 0.001 inch, and countersink them at a 90-degree included angle to 0.450 inch diameter. The tapping heads at the second and fourth stations operate on lead-screws to accurately produce 0.438-inch diameter tapped holes with twenty threads per inch.

The machining of forged aluminum cylinder heads, the assembly of air-cooling fins in cylinder barrels, and the equipment used for this work at the Wright plant will be described in the second installment of this article.



VALVE guides, cam bearings, connecting-rod bushings, propeller-blade bushings, and other parts made of bronze alloys are used extensively in aircraft engines. At the American Non-Gran Bronze Co., Berwyn, Pa., especial care is taken in machining these parts to insure dimensional accuracy, and casting methods are closely controlled to obtain a high degree of wear resistance.

Known as "Non-Gran," the bronze alloy produced by this firm contains 87 per cent of copper, 11 per cent of tin, and 2 per cent of zinc. The machining qualities of this material approximate those of cold-rolled steel. Based on the number of foot-pounds of energy required to cut a standardized chip from various materials, the machinability rating of "Non-Gran" bronze is 3.45, compared with 3.4 for cast iron and 7.0 for cold-rolled steel. Some typical parts made of this bronze alloy are illustrated in Fig. 1.

In addition to the regular spot-checking by machine operators as these parts are processed through the plant, special inspectors are assigned to double check the work at the machines. Many parts are given 100 per cent inspection before proceeding to subsequent operations.

The cam bearing illustrated in Fig. 2 is one of the most interesting of these bronze-alloy aircraft parts. This bearing, made for the Pratt & Whitney 2400-H.P. "Double Wasp" engine, is cast in a green sand mold on an end-draw metal-plated pattern which allows 1/8 inch of stock all over for machining purposes. Approximately eighty molds are poured for this part in a day (Fig. 3).

After cutting off the gate and riser with a "Radiac" abrasive wheel and blending the cut-off marks, the castings are sand-blasted to remove all scale. The first machining operation (see heading illustration) is performed on a tur-

Making and Inspecting Bronze Aircraft-Engine Parts

By A. P. McGINNES, JR.
Engineering Manager
American Non-Gran Bronze Co.
Berwyn, Pa.

Grumman F8F-2 "Bearcat" Carrier-Based Fighter

Bronze-Alloy Parts for Aircraft Engines Require Great Resistance to Wear, as well as a High Degree of Dimensional Accuracy. Some of the Means by which These Characteristics are Obtained are Described in This Article

ret lathe, where the inside diameter is rough-bored to 11.545 inches, plus or minus 0.005 inch, for a depth of 13/16 inch. Carbide-tipped tools mounted on a square turret on the cross-slide are employed, using a feed of 0.011 inch per revolution and a spindle speed of 365 R.P.M. The rate of production on this operation is approximately eight pieces per hour.

Rough-turning the outside diameter to 11.935 inches, plus or minus 0.005 inch, and rough-facing the surface having the six lugs, is accomplished at the rate of about ten pieces per hour. A special, three-jaw air chuck holds the bearing on the inside bore for this operation, as seen in Fig. 4. To insure a high degree of concentricity and roundness in this turning operation, a light cut is taken on the periphery of the pads that hold the work, after which the pads are checked with a dial indicator for concentricity, which must be within 0.002 inch total indicator reading. This is done each time the job is set up in the turret lathes.

An outward movement of 0.003 inch by each of the three pads, or jaws, provides sufficient pressure to clamp the work securely without distortion. The jaw movement is closely controlled by means of adjusting screws located around the periphery of the chuck. After an adjustment has been made, the adjusting screws are locked in position by means of set-screws. Carbide-tipped tools are used in the rough-turning operation, the same speeds and feeds being employed as in rough-boring.

A faceplate with four clamps is used on a turret lathe to hold the work for finish-boring the inside diameter of the bearing. This set-up is the same as that shown in the heading illustration for rough-boring. Three cuts are taken, 0.012 to 0.015 inch of stock being removed in each of the first two, and about 0.005 inch in the

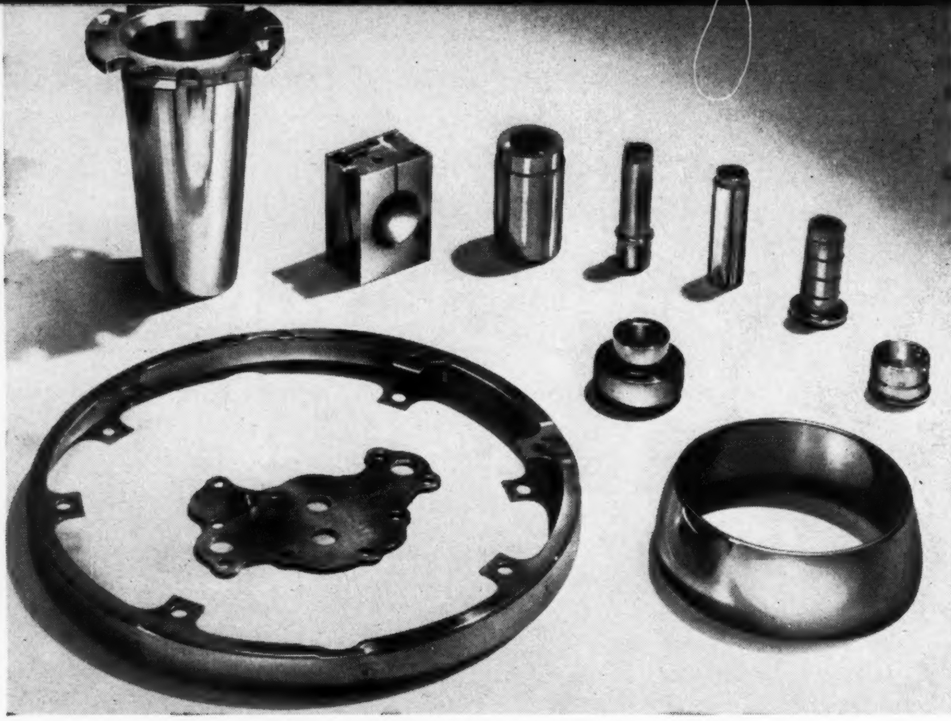


Fig. 1. Typical bronze-alloy parts used in aircraft engines. A propeller-blade bushing is shown in the upper left-hand corner, and a cam bearing, with a cover plate for the accessory section of a jet engine inside, in lower left-hand corner

third. Before taking the last cut, the clamps are loosened to permit the thin-walled work to assume its normal shape in the event that it has been slightly distorted by the clamping pressure. This eliminates the possibility of machining the bore to a distorted form.

In this operation, the bore is machined to 11.625 inches, plus or minus 0.001 inch. A spindle speed of 340 R.P.M. is used with a feed of 0.007 inch per revolution for the first two cuts, and of 0.003 to 0.005 inch per revolution for the final cut. Using carbide-tipped tools, about five to six bearings per hour are finish-bored.

This operation is followed by rough-finishing the outside diameter and the lug face, leaving 0.008 to 0.010 inch for the final finishing operation. The same type of air chuck as is used for rough-turning the outside diameter holds the work for this operation. Approximately six bearings per hour are turned and faced, using carbide-tipped tools and a spindle speed of 266 R.P.M. To avoid distortion, light feeds are used in all machining operations after roughing. In this case, a feed of 0.003 to 0.005 inch per revolution is used.

Especial care must be taken in all machining

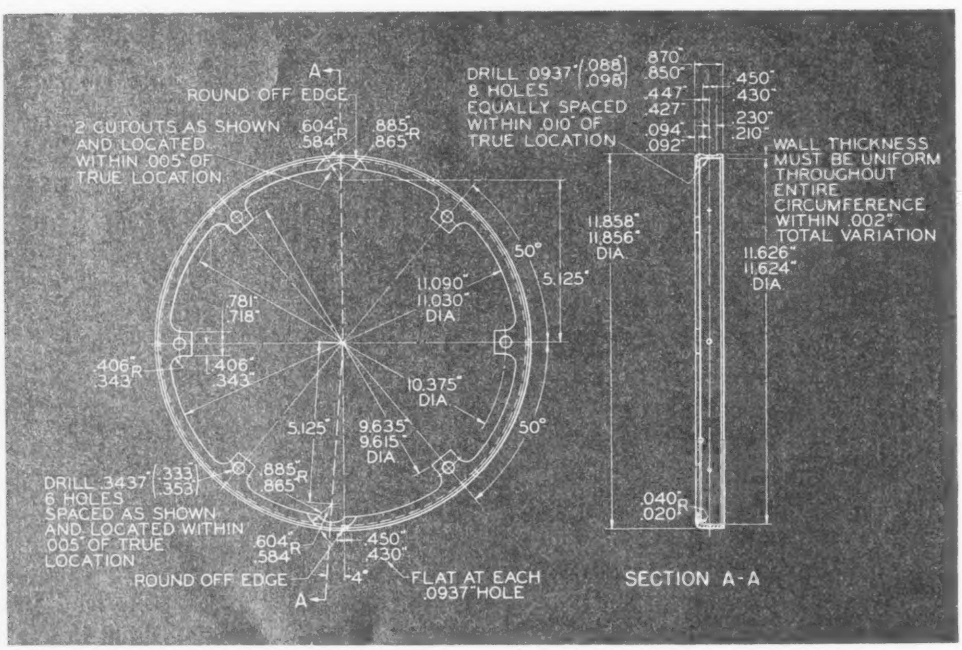


Fig. 2. Bronze-alloy cam bearing for the 2400-H.P. Pratt & Whitney "Double Wasp" engine

Fig. 3. Pouring molds for the cam bearing illustrated in Fig. 2

operations to avoid tool marks and scratches. Moreover, all burrs must be removed from holes and edges, in order to prevent minute particles, which might break loose when the part is in operation, from traveling through the oil-lines of an engine and causing damage to the system. A burring operation follows the rough-finishing of the outside diameter. Scale is removed from the inner edges of the lugs and the cast radii are blended. Using hand grinders, this operation is accomplished at the rate of eight pieces per hour.

The drill jig illustrated in Fig. 5 is used to produce fourteen holes in each bearing. The sizes and locations of these holes in the lugs and around the periphery of the bearing may be seen in Fig. 2. High-speed steel drills are employed (using a coolant) with this jig to completely drill eight bearings per hour. Following the drilling operation, the holes on the periphery are burred with a counterboring tool, which is positively stopped at the end of its stroke. The lug holes are burred with mounted wheels in small hand grinders.

Next, the outside diameter of the bearing is finish-turned to 11.857 inches plus or minus 0.001 inch. The same air chucks are used in this set-up as in the previous operations. The bearings are then 100 per cent inspected for wall

Fig. 4. A special, three-jaw air chuck is used on an engine lathe to securely hold thin-walled cam bearings without distortion during turning operations

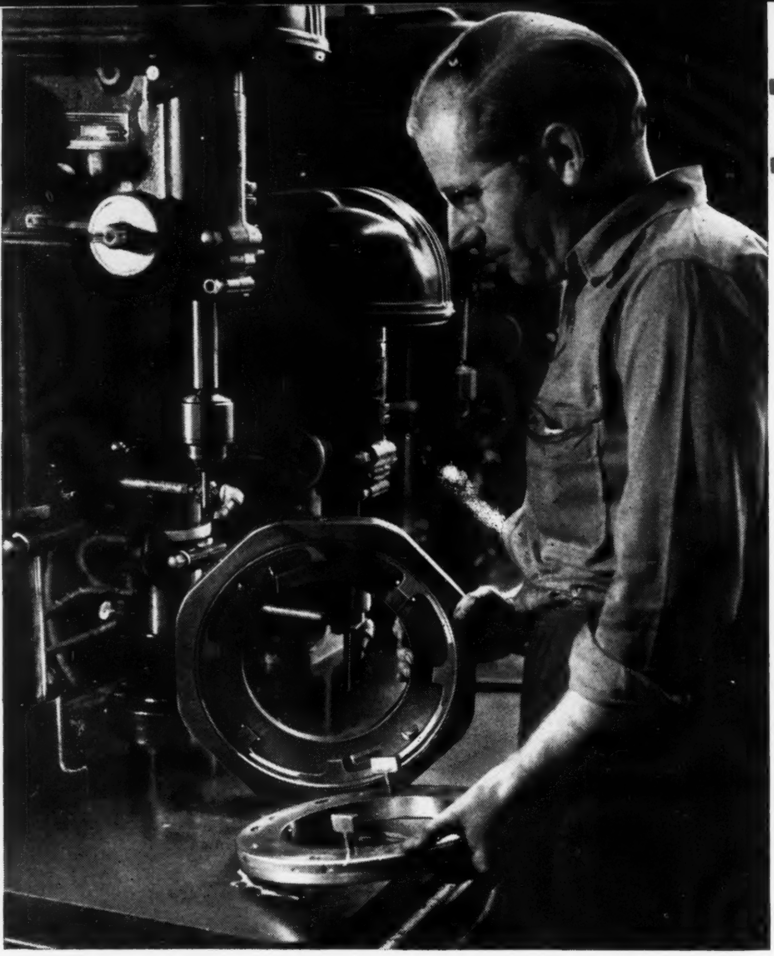


Fig. 5. This jig locates and clamps the work for drilling eight equally spaced holes around the periphery and six holes in the lugs

thickness and concentricity with the gage illustrated in Fig. 6.

This gage has several hardened and ground straps on which the work is placed during inspection. Two additional straps, having carbide inserts to provide wear resistance, are assembled at right angles to each other, forming a vee for use as locating surfaces. A ring containing handles, which fits into the finished bore of the work, serves as a plug gage. The ring and work are rotated together while bearing against the locating surfaces, so that the work can be checked for concentricity by means of a dial indicator. Concentricity must be within 0.002 inch total indicator reading.

The edge radii and radial recesses (see Fig. 2) are produced on a vertical milling machine equipped with a rotary table as illustrated in Fig. 7. A stepped, high-speed steel cutter is used to mill the radial recesses at the same time the radii are cut into the edge of the lug face. The work is indexed by the rotary table for accurately locating the work for this operation. It will be noted from the drawing, Fig. 2, that one of the radial surfaces is offset 4 degrees relative to the other. Approximately ten bearings are milled per hour, including spot-checking with a special plug gage.

Fig. 6. Cam bearings are 100 per cent inspected for concentricity within 0.002 inch total indicator reading by this gage, which also checks the size of the bore

Fig. 7. A stepped, high-speed steel end-mill is used in a vertical milling machine for cutting radial recesses and edge radii in cam bearings. The work is clamped on a rotary table for accurately indexing to required positions

Another milling operation required on these bearings is the machining of shallow flats at each hole on the periphery. For this operation, the work is clamped in a flat, open-sided jig on the table of a horizontal milling machine. Indexing the cutter is accomplished by inserting a pin, through the jig body, into one of the holes in the work.

The sharp edges of these flats are smoothed and blended into the contour with a rubber wheel, mounted in the spindle of a drill press. Among the final operations on these bearings are other blending operations. One of these consists of the blending of the intersection of the wall with the inside diameter. A low-speed motor is used to apply fine emery cloth for this operation, and the outside diameter is treated in the same manner.

In the final inspection procedures, all dimensions are checked and hole sizes and locations are inspected by means of a special gage which checks the size and relative locations of the edge radii at the same time. In addition to dimensional inspections, every cam bearing is carefully checked for casting defects.

The wear resistance of these cam bearings and other engine parts made of Non-Gran bronze is the result of a carefully controlled foundry process in which only virgin and primary metals are used. This method of casting produces a homogeneous, non-granular structure which contains needle-like fibers that are interlocked in a high degree of molecular cohesion, resulting in a material with great resilience.

Intricate Parts for Jet Engines Cast by the Lost Wax Method

By GEORGE H. DeGROAT

North American F-86 "Sabre" Jet Fighter

SMALL jet-engine parts of complicated shape that would be impractical or uneconomical to machine are produced by the precision investment casting process. At the Bayonne, N. J., works of the International Nickel Co., Inc., many such parts requiring heat and corrosion resistance, as well as high strength, are made in large quantities by this method, using Stellite, Inconel, Monel, nickel, and similar alloys.

Typical of these precision-cast parts are the Stellite partition nozzles employed in the turbo-jet engine that is used to power the North American F-86 fighter, as well as the B-45 twin-engine bomber. Sixty-four nozzles are assembled in a diaphragm in this engine to direct the flow of gases to the turbine wheel. These parts closely resemble a hollow blade having an airfoil contour, and are almost impossible to produce by machining.

The first step in making the partition nozzles by precision investment casting is the construction of a master pattern. This is produced in accordance with specifications for the finished part, except that all dimensions are increased by approximately 1 1/2 per cent to allow for casting shrinkage. Inasmuch as the shrinkage differs with the shape of the part and the location of varying cross-sections, the pattern dimensions are held to a tolerance of plus or minus 0.001 inch, so as to provide an accurate basis for calculating actual shrinkage when necessary. Usually, these patterns are made of brass, stainless steel, or Monel to prevent corrosion.

The master pattern is embedded in plaster-of-paris up to the desired parting line, in one half of a two-piece metal box, or flask, as shown in Fig. 1. The plaster-filled half of the flask is then placed in a specially constructed screw press and the empty half placed over it, Fig. 2. Accurate alignment of these two parts is insured by dowels. A low melting-point alloy consisting of 50 per cent tin and 50 per cent bismuth is next poured into the empty flask at a casting temperature of approximately 380 degrees F. To insure a perfect casting, air pressure of 100 pounds per square inch is applied while pouring.

The alloy fills the empty half of the flask, forming half of the master mold, or die, from which wax patterns are made. After the alloy hardens, the two parts of the flask are disassem-

bled and the plaster-of-paris is removed from the first half. The cast half mold is then trimmed and polished, and the master pattern is inserted in the mold. Upon reassembling the two halves of the flask, and clamping them in the press again, the pouring process is repeated, this time filling the first half of the flask which is now empty.

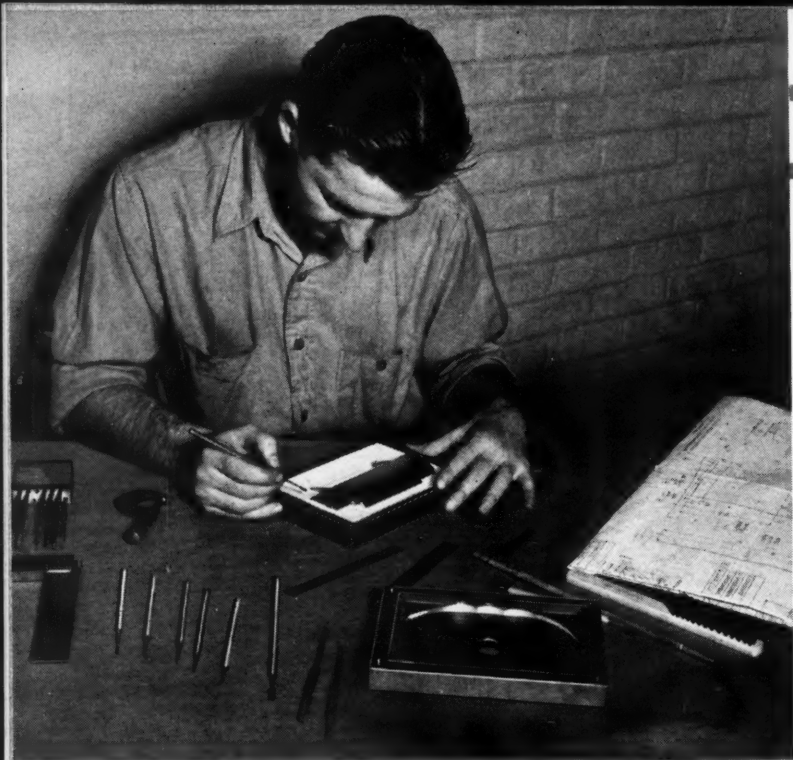
The result is a two-piece mold, Fig. 3, into which wax is injected to form individual wax patterns. To make the nozzles hollow, a core insert is used with the master mold when injecting the wax. Seats for the core are cast into the mold by means of the extensions on both sides of the master pattern. The mold, master pattern, core insert, and a wax pattern are illustrated in Fig. 4.

For casting the wax patterns, the two half sections of the master mold are clamped together and placed in an injection machine. The wax is injected into the mold at a temperature of 180 degrees F., under a pressure of 600 pounds per square inch. Fig. 5 shows the mold opened for removing the wax pattern, several other patterns being seen on racks in the background.

Any changes in room temperature and humidity would cause the wax to become deformed, resulting in dimensional variations. For this reason the molding, wax-preparation, and other areas in this plant are air-conditioned to maintain constant temperature and humidity. To further insure high dimensional accuracy in these patterns, a brittle wax is used, which breaks before deformation.

Six individual wax patterns of the nozzle are assembled on a sprue, as shown in Fig. 6. The sprue serves the dual purpose of gate and riser. In general, the number of patterns assembled on a sprue is determined by the gating, which is designed to provide soundness and dimensional control in the casting.

To obtain a smooth, hard, highly refractory surface in the mold cavity against which the metal will be cast, the pattern assemblies are dipped in a bath of silica flour suspended in sodium silicate, which has a paint-like consistency (see Fig. 7). Suitable wetting agents are added to insure the full coating of the patterns. While the surfaces are still wet, a coarser silica sand is dusted over the pattern to provide a



INTRICATE PARTS FOR

Fig. 1. A master pattern, made to close tolerances in accordance with finished-part specifications, is embedded in plaster-of-paris in one half of a flask preparatory to casting a master mold

bonding grip between the "dip coat," or "primary investment," and the secondary investment molding material, which is applied subsequently.

The coated pattern assembly is then mounted on a steel plate, Fig. 8, to which it is fastened by means of a quick-hardening wax. An Inconel flask, lined with wax paper and open at both ends, is placed over the pattern assembly and likewise sealed with quick-hardening wax to close off the bottom as indicated in Fig. 9.

Next, dry investment material is mixed with a liquid binder and poured into the flask to form the "secondary investment." The flask and its contents are then loaded on jolting tables and "jolt-packed" for about an hour to eliminate entrapped air and to pack the coarser particles

Fig. 2. A two-piece flask containing the master pattern is placed in a special press for casting the master mold

Fig. 3. The master mold, in which wax patterns are made, is carefully finished after being cast of a low melting-point alloy

of the investment material into the lower section of the flask. Excess liquids and finer particles rise into the paper lining which extends several inches above the flask.

After the investment material hardens, the excess material above the flask is removed. The "invested flasks" are then marked with identifying code numbers or letters, and after being dried in air for eight hours, they are loaded into gas-fired, automatically controlled ovens. The wax pattern and sprue melt out of the investment at a temperature of about 250 degrees F., after which more drying takes place. A minimum of four hours is required for this baking operation. Each flask now contains cavities into which molten Stellite can be poured to cast six nozzles.

Before receiving this charge of metal, however, the flasks are placed in a 30-foot long, pusher type, gas-fired furnace having automatic temperature controls, as shown in Fig. 10. Using an oxidizing atmosphere, this furnace burns out the carbonaceous residue left in the investment, or mold, by the wax. The temperature, starting at 400 degrees F. at the charging end, rises uniformly for two-thirds the length of the furnace to 1600 degrees F.

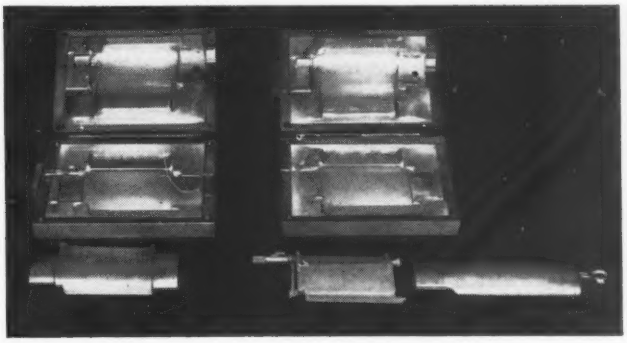


Fig. 4. Finished master molds (top), master pattern (left foreground), wax pattern (center foreground), and core insert (right)

After being preheated for six to eight hours, the flasks are removed from the furnace while they are hot and clamped in position on electric-arc melting furnaces. These furnaces, shown in the heading illustration, contain the metal from which the nozzles are to be cast. Having been brought to the proper pouring temperature by the time the flask is placed in position, the metal is poured into the mold cavities through the sprue opening in the flask. This is done by inverting the furnace and by supplementing gravity feed-

Fig. 5. After injecting wax into a master mold, patterns are removed and placed in racks preparatory to mounting on sprues

Fig. 6. Six wax patterns of the partition nozzles are mounted on a sprue that serves the dual purpose of gate and riser

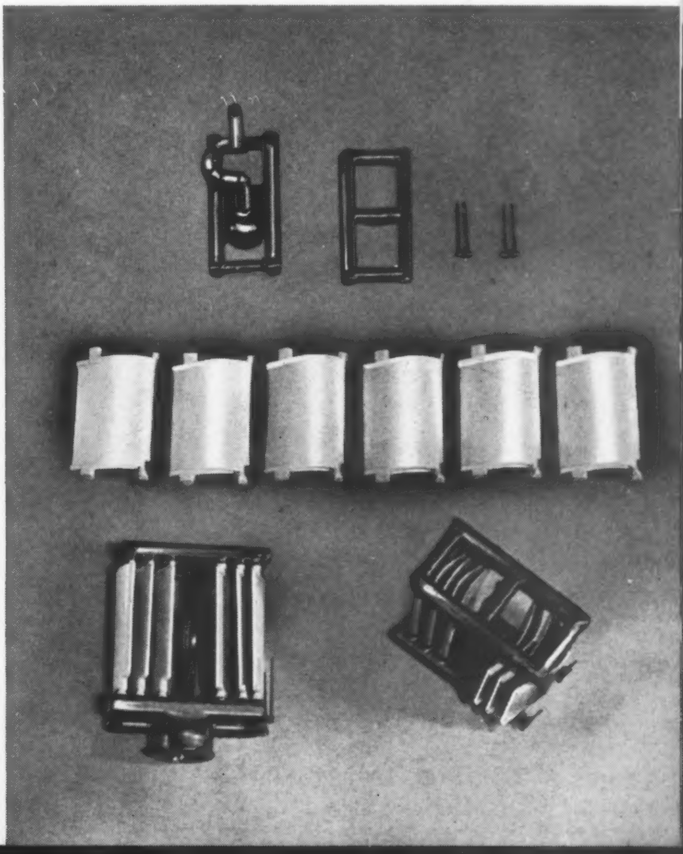


Fig. 7. The patterns are provided with a "dip coat" to give the mold cavity a hard, smooth, highly refractory surface

Fig. 8. A "dip coated" and sanded wax pattern is fastened to a steel plate with wax, and an Inconel flask placed over it

Fig. 9. Quick-hardening wax is also poured around the bottom of the Inconel flask containing the wax pattern assembly to fasten it to the steel baseplate

Fig. 10. After melting the wax out of the flasks, the molds are preheated for six to eight hours preparatory to casting the Stellite partition nozzles

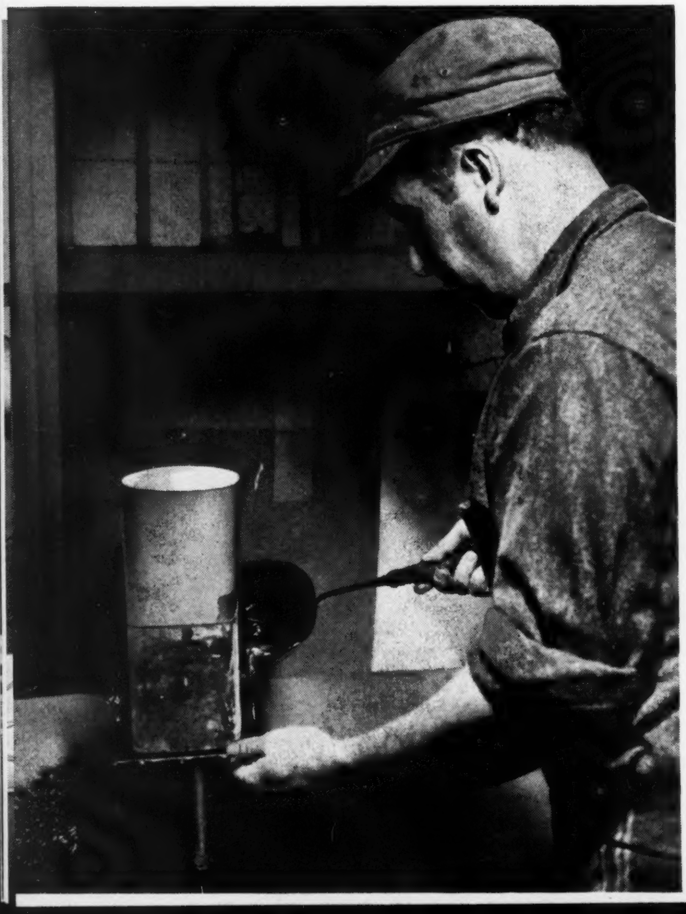


Fig. 11. A pneumatic hammer is used to break the hardened secondary investment in order to remove castings from mold

Fig. 12. Cast partition nozzles are radiographically inspected for soundness before grinding the airfoil contours

ing with an air pressure of 3 to 5 pounds per square inch to force the metal into the cavities.

When the molds and castings are cool, the investment material is knocked out of the flask by means of a pneumatic hammer, as seen in Fig. 11. The castings are then cleaned by sand-blasting to remove any sand and investment material that may cling to them. A high-speed abrasive cut-off wheel is employed to remove the sprue and gates, after which the cast nozzles are radiographically checked for soundness (Fig. 12). This is followed by a grinding operation on abrasive belt sanders to produce a high surface finish on the airfoil contours, after which the nozzles are given a steel-grit blast.

Final inspection of these parts includes visual checking for surface finish and checking of the dimensions in accordance with blueprint specifications and the master pattern, Fig. 13. Contour inspection—the last step in the production of these intricate parts—requires the use of specially built dial indicator gages.

Fig. 13. Both standard and special gages are employed in inspecting precision-cast partition nozzles for dimensional accuracy

Jet-Engine Components Cast Centrifugally in Permanent Molds

McDonnell FD-1 "Phantom" Carrier-Based Jet Fighter

By THOMAS S. QUINN, JR.
Plant Superintendent
Lebanon Steel Foundry
Lebanon, Pa.

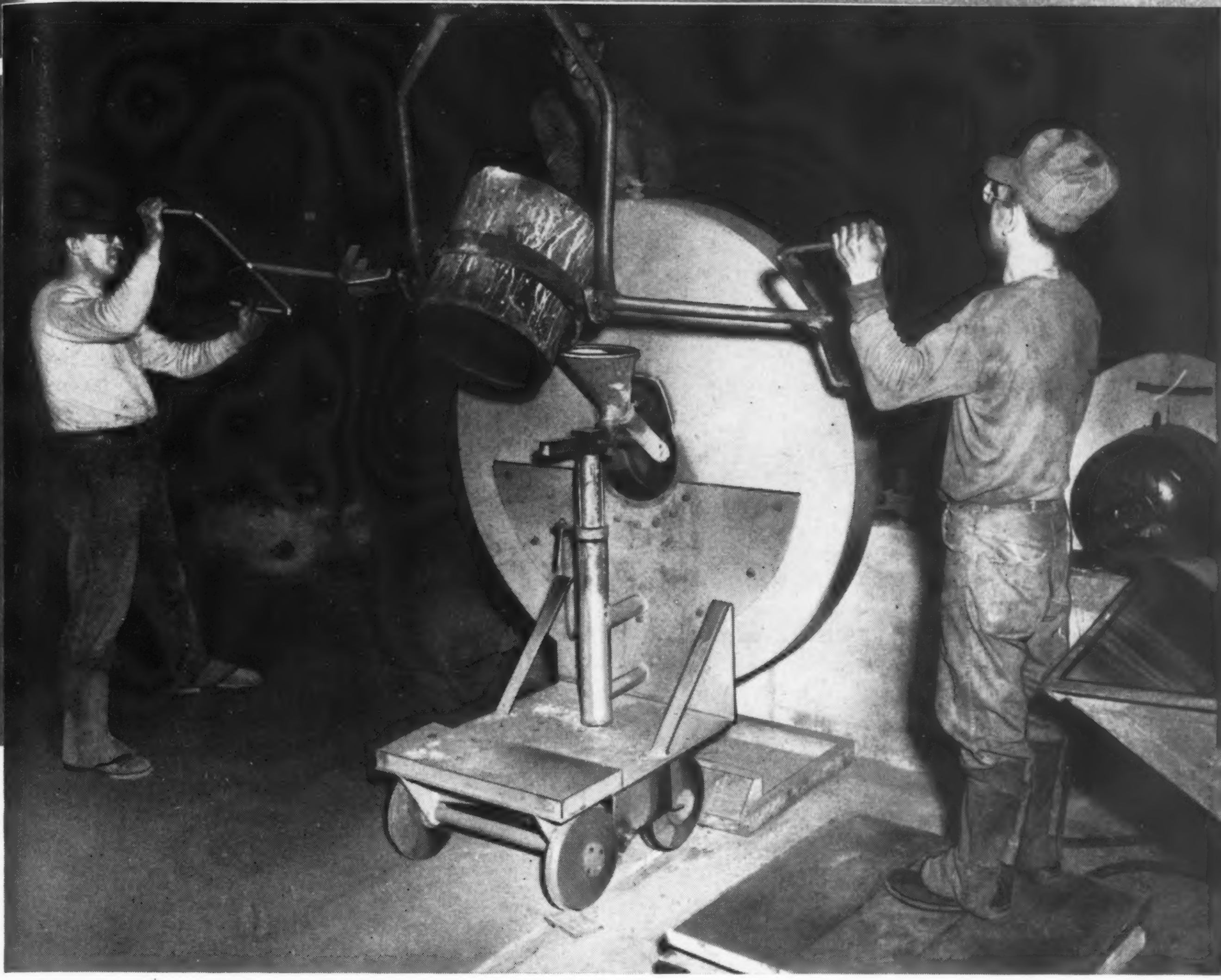
High-Temperature Resistant Alloys Required in Aircraft Jet Engines are Cast Centrifugally in Permanent Metal Molds by the "Centri-Die" Process Developed by Firth-Vickers Stainless Steels, Ltd., and Licensed to Lebanon Steel Foundry

ALTHOUGH the idea of centrifugal casting was conceived about 140 years ago, the successful application of this process to the casting of high-quality steel is comparatively recent. A variation of centrifugal casting known as the "Centri-Die" process was perfected by Firth-Vickers Stainless Steels, Ltd., Sheffield, England, during the war. This process, refined in the course of producing more than 1,000,000 aircraft engine components, made possible the casting of high-temperature resistant alloys required in the manufacture of the Rolls-Royce "Nene" and practically all other British turbo-jet engines.

Hailed as one of the most important improvements in a generation of alloy-steel foundry progress, this process, the details of which have been kept secret up to the present time, has been acquired by the Lebanon Steel Foundry, Lebanon, Pa., for use in the production of turbo-jet components needed in the United States $500,000,000 aircraft engine program. Aside from its immediate importance in warplane engine manufacture, the process gives definite promise of adaptability in a variety of new industrial uses. The high-alloy steel casting facilities of this company have been materially expanded by a $500,000 program designed for the specialized "Centri-Die" operations.

In true centrifugal casting practice, a circular mold or die is rotated about its axis, either horizontal or vertical, while pouring the molten metal and cooling the casting. No center core is employed, the centrifugal force causing the liquid metal to take the shape of the mold into which it is poured as it solidifies, cooling from the outer surface toward the center. The "Centri-Die" process employs permanent metal molds in place of refractory molds.

Among the advantages of centrifugal castings are their high quality, dense structure, and uniformity of strength. The heavy metal is driven outward away from the axis of rotation by centrifugal force, while the lighter slag and gas



inclusions are present only near the bore of the casting and can be subsequently removed by machining. The fine-grained, structurally stable, sound casting thus obtained has good physical properties. Complex shapes that are difficult or impossible to produce by other methods, and high-temperature resistant alloys, can be cast centrifugally at a reasonable cost, with practically no rejections.

At the present stage of development, "Centri-Die" castings must approximate a cylindrical shape. However, flanged rings or bushings can be cast by this method. Variations in the desired cross-section are obtained by machining the rough cylindrical casting. It is common practice to machine a number of rings from each casting or cylinder blank, as shown in Fig. 1. Jet-engine components that can be produced in this way include turbine shroud rings, turbine labyrinth seals, nozzle guide-vane support rings, outer nozzle rings, and turbine stator rings.

Typical high-temperature resistant alloy rings centrifugally cast in permanent metal dies by means of the "Centri-Die" process are seen in Fig. 2. Many variations in the diameter, length, and thickness of the rings can be obtained. The rings shown have been machined to the specified shape and size after casting. The facilities at the Lebanon Steel Foundry are capable of producing "Centri-Die" castings up to 42 inches in diameter and up to approximately 3 feet in length.

All materials can be centrifugally cast in this way, but the process is especially adaptable to alloys capable of withstanding the heat, centrifugal forces, thermal stresses, corrosion, and vibration encountered in aircraft gas turbines. One austenitic, heat-resisting steel, known as 24-12-3 and containing about 24 per cent chromium, 12 per cent nickel, 3 per cent tungsten, 0.25 per cent carbon, 1 per cent silicon, and 0.50 per cent manganese, is cast into cylindrical shapes as large as 30 inches in diameter and weighing more than 500 pounds. Such castings

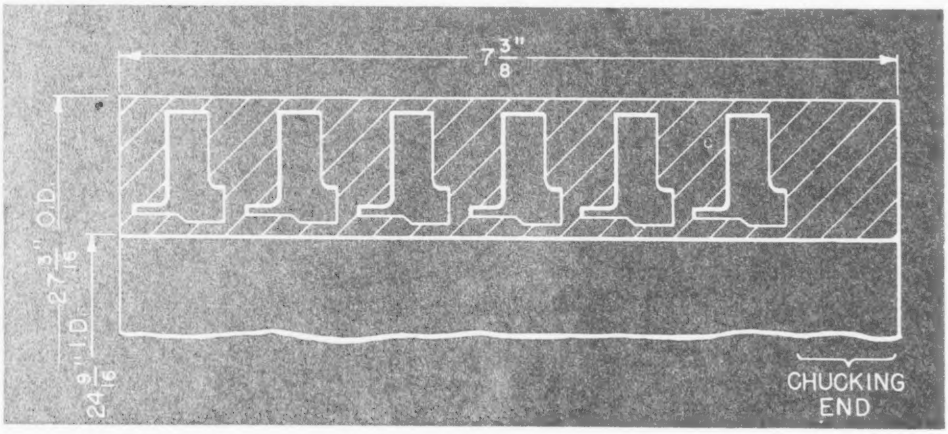


Fig. 1. Six high-temperature alloy rings for aircraft jet engines can be machined from a single centrifugal casting, 7 3/8 inches wide

are machined into rings required in turbo-jet engine construction, and have been successfully employed in the Pratt & Whitney Aircraft "Turbo-Wasp"—American version of England's famous "Nene"—and other American-made jet engines.

"Centri-Die" castings are made in either vertical- or horizontal-axis machines. The choice as to the type of machine for producing any particular part depends upon the shape and design of the part. As a general rule, horizontal machines are employed to centrifugally cast parts where the length of the part is greater than its radial thickness. Conversely, where the radial thickness of the part is greater than the length, vertical machines are used. The contour of both the outer periphery and bore of the casting can be controlled on vertical machines, while only the outside shape of the casting is controlled on horizontal machines. Variations in bore size, from top to bottom of the casting, can be controlled on vertical machines by varying the speed of rotation.

Specially designed "spinning" machines built by the Centrifugal Casting Machine Co., Tulsa, Okla., are employed in the "Centri-Die" process at the Lebanon plant. Three of the casting machines are of the vertical type, set in pits in the floor to facilitate pouring, and two are of the horizontal type. One of the horizontal machines, powered by a 30-H.P. motor, is capable of spinning a combined load of 10,000 pounds (molten metal plus die weights) at a maximum speed of 1200 R.P.M. Each machine is equipped with electronically controlled speed regulation, insuring maintenance of the desired speed of rotation within 2 per cent.

The permanent metal dies used in this process are made from specially developed low-alloy steels. The choice of die material depends primarily on the shape of the casting, the material from which the casting is made, and the tem-

Fig. 2. Typical rings centrifugally cast in permanent metal dies by the "Centri-Die" process. The rings illustrated have been machined to size after casting

Fig. 3. Temperature- and corrosion-resistant alloys are melted in tilting type induction furnaces. The melting temperature is controlled within a range of 5 degrees F.

perature to which it must be heated for melting. Metal dies or molds have several advantages over those made of refractory material. For example, the danger of the casting absorbing dirt caused by erosion of the mold is eliminated; the grain size of the casting is generally smaller, due to more rapid cooling; and the cost of production is lower, since the life of a single metal die varies from 350 to 500 castings, while a separate refractory mold is required for each centrifugal casting.

The ring-shaped metal dies are mounted between a removable backplate and a faceplate, the assembled unit being held in a cup-shaped container which is bolted to a flange on the spindle of the centrifugal casting machine. There is an opening in the center of the faceplate for the pouring spout through which the molten metal flows. The pouring spout is held in the center of a circular sheet-metal protective plate, mounted on a portable dolly.

Before casting, steps are taken to condition the die by preheating and spraying. The bore of the die ring is sprayed with a specially developed wash which retards the cooling action of the die on the molten metal and prevents the metal from freezing to the die. This wash also facilitates removing the solidified casting from the die after cooling, and lengthens the life of the die.

The metal to be centrifugally cast is melted in one of four 1000-pound capacity Ajax-Northrup tilting type induction furnaces. A molten charge of uniform, closely controlled alloy is poured from each furnace, Fig. 3, approximately every sixty minutes. The melting temperature,

Fig. 4. After spinning for from three to five minutes, rotation of the die is stopped. The casting is allowed to cool in the die, after which it is removed by tongs

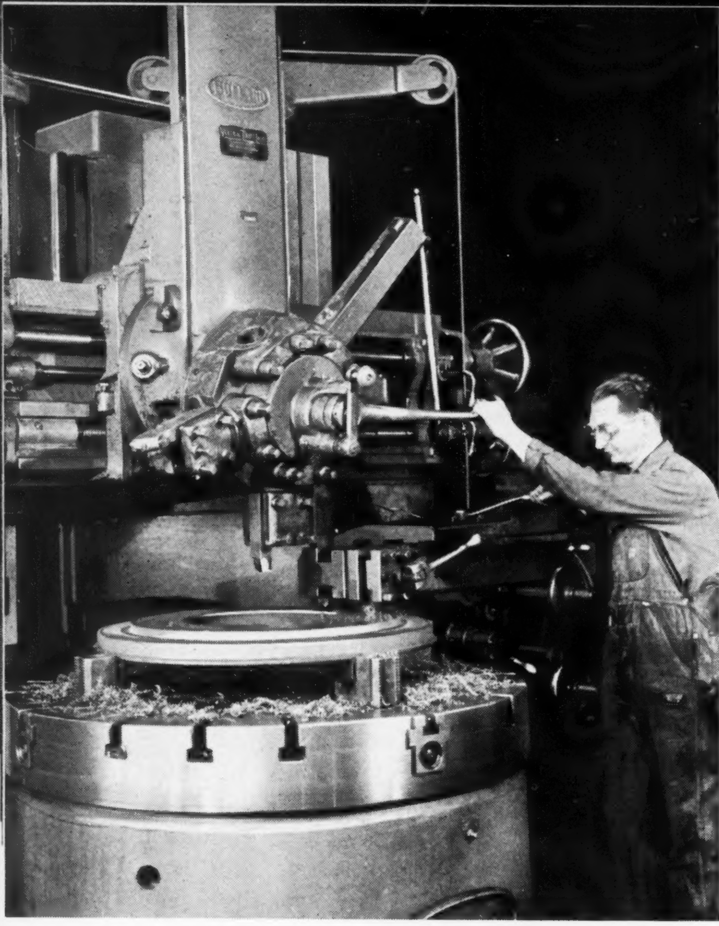


Fig. 5. Surfaces of the centrifugal casting are machined to facilitate visual inspection

Fig. 6. One-million volt X-ray machine employed to examine large centrifugal castings produced in refractory molds, and "Centri-Die" castings when required

which varies with the alloy, is accurately controlled within ± 5 degrees F. by immersion type thermo-couples and recording pyrometers. Motor-generator sets are employed to supply 960-cycle, single-phase current to these 350-kilowatt induction furnaces.

Since the bore diameter of the casting depends upon the amount of molten metal poured into the die, the weight of the metal charge is closely controlled to approximate that of the specified ring. This is accomplished by placing the ladle, with its molten charge of metal, on a platform scale. The weighed charge is poured into the rotating die of the spinning machine, as seen in the heading illustration. Speed of rotation varies from 100 to 1200 R.P.M., depending upon the design and size of the casting.

The casting is spun for from three to five minutes. During spinning, an insulating material of lower specific gravity than the metal being cast is sprayed through an opening in the face-plate. This material minimizes the transfer of heat from the inner periphery of the casting to the air, and permits the casting to solidify from its outer periphery inward, as desired. After the machine has been stopped, the casting is allowed to cool in the die for about five minutes.

A "Centri-Die" casting is shown being removed from a horizontal spinning machine in Fig. 4. Tongs placed in the bore of the casting are employed to remove the casting from the die. For removing flanged parts, the die has to be disassembled. On castings spun in vertical machines, there is a thin layer of metal across the bottom which can be removed with a hammer.

"Centri-Die" castings are machined on a Bullard vertical turret lathe, Fig. 5, to remove any "as-cast" surface skin, approximate the finished size of the desired part, and obtain a good surface finish. From 3/16 to 1/2 inch of stock is removed from all surfaces of the casting, the amount varying with the size of the part. Defects on the surfaces of the casting can be easily detected by visual examination after the machined part has been subjected to a hot acid pickle bath for about ten minutes. Paraffin "chalk," rubbed into the surfaces of the casting, is sometimes substituted for pickling in this inspection. Precision control of all processing steps and comprehensive laboratory testing have resulted in a minimum number of rejections.

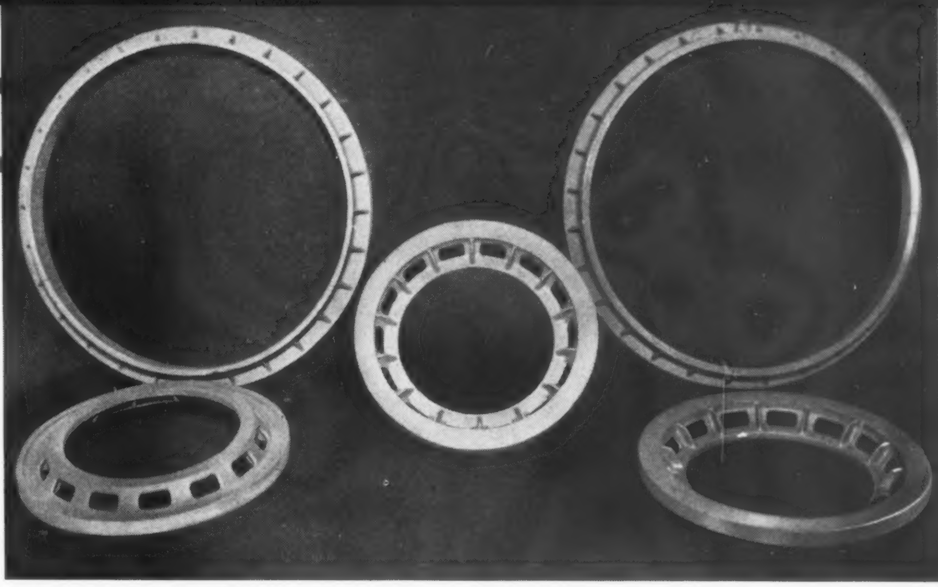


Fig. 7. Complex-shaped parts such as these gas-turbine components are centrifugally cast in sand molds

Experience based on the production of more than 1,000,000 aircraft engine components in Britain and at Lebanon has indicated that X-ray examination is not required for "Centri-Die" castings that have been properly inspected visually. However, X-ray examination to assure 100 per cent internal integrity is performed in Lebanon Steel Foundry's Air Force Certified Radiographic Laboratory when required by the customer's specifications.

Centrifugal castings produced in refractory molds and subjected to stressed conditions in service are always examined by X-ray (Fig. 6) because it is difficult to machine the more complex shapes thus produced, and the chances of internal defects in such parts are greater. Magnaflux or Zyglo inspections are also performed on these parts, depending upon whether the alloy cast is magnetic or non-magnetic.

Inspected castings of the high chromium-nickel 24-12-3 alloy previously described are heat-treated by normalizing at approximately 2000 degrees F., and quenching in water. Heat-treatment is accomplished in controlled-atmosphere, gas-fired furnaces. The surfaces of the heat-treated castings are conditioned by sand-blasting.

Vaned and other complex-shaped parts, such as those shown in Fig. 7, are centrifugally cast in sand molds. Some of these castings are considerably more expensive than "Centri-Die" castings, since complex sand cores must be made for each individual part. Sand vane cores employed in centrifugally casting stationary guide vane rings for turbo-supercharger diaphragms are shown in Fig. 8. Removable metal templets, seen at the right, are employed in making the cores. A completed sand vane core is seen at the lower left. After baking, the vane core is set inside a drag core. A cope core is placed on top, and the assembly is ready for pouring of the molten metal and centrifugal casting.

In addition to the various jet-engine applications mentioned, the "Centri-Die" process is readily adaptable to the production of a variety of bushings, valve seats, pump liners, and other cylindrical and circular shapes in a wide range of alloys. The process is considered to offer particularly significant possibilities for the production of circular shapes required by the oil, textile, chemical, paper, and pulp industries, and others in which there is need for cylindrically cast parts of heat-resistant or corrosion-resistant metals and components for sub-zero service.

Fig. 8. Removable metal templets are employed in molding sand vane cores. A completed vane core is seen at the left

Machining Landing-Gear Parts for Huge Modern Bombers

Landing Gear of Consolidated-Vultee B-36 Bomber

By R. E. GREENOUGH
Chief Engineer
The Cleveland Pneumatic Tool Co.
Cleveland, Ohio

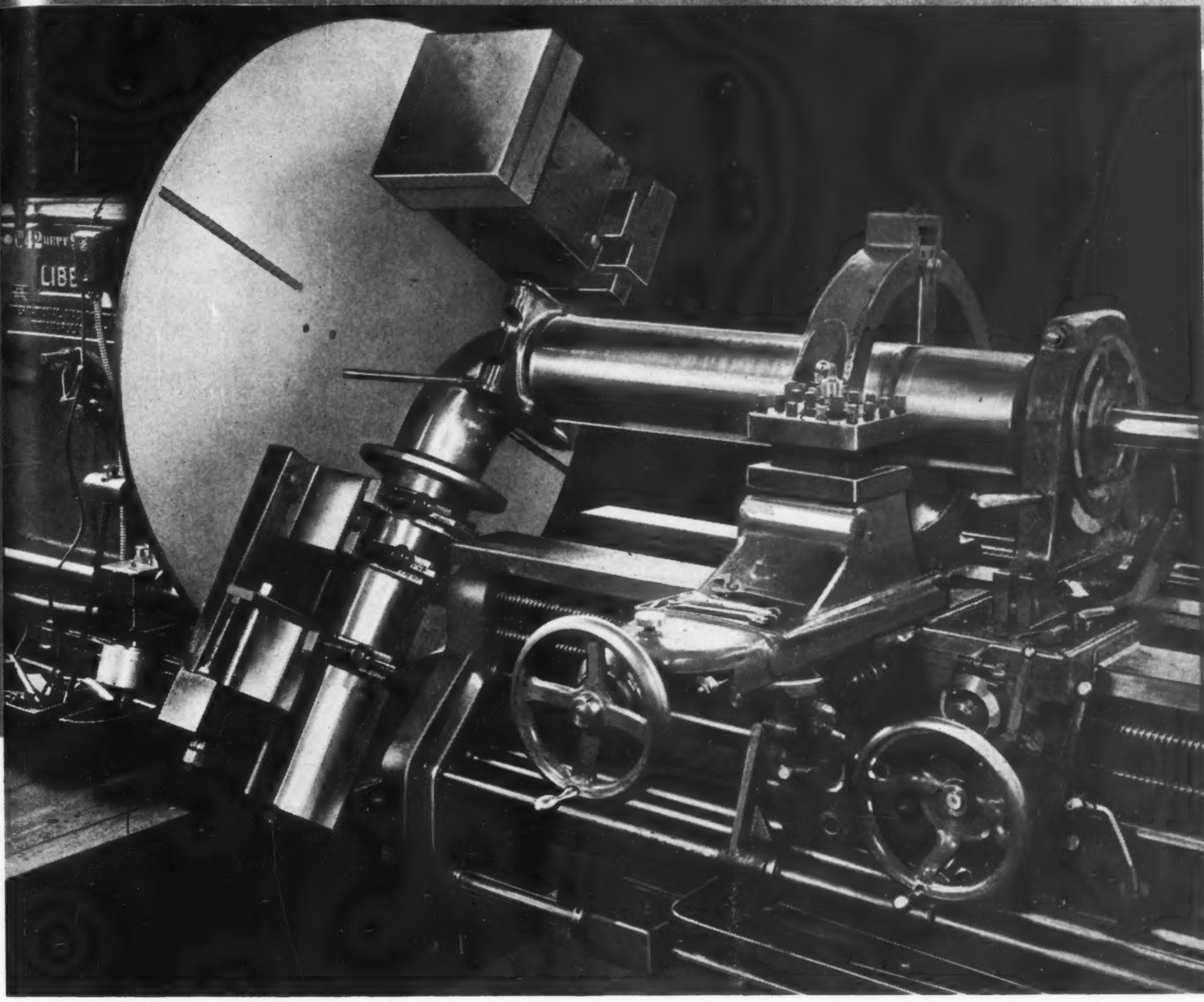
Close Tolerances, Smooth Surface Finish, Maximum Strength, and a High Degree of Uniformity are Required in the Landing-Gear Parts for the Huge Bombers being Built for This Country's Modern Air Force

EXACTING specifications to insure minimum weight and size while maintaining maximum strength and safety of aircraft landing-gear parts have necessitated precision machining, closely controlled heat-treatment, and careful inspection during their manufacture. Landing gear for the huge bombers now being built for this country's Air Force must withstand the severe shock imposed by landing with a weight of more than 140 tons at speeds exceeding 100 miles per hour, even at sub-zero temperatures. Failure of even a small landing-gear part can mean the loss of many lives and the destruction of a million-dollar investment in a few seconds.

Boeing B-50 Super-Fortress bombers, one of which recently completed the first non-stop flight around the world, have a normal gross weight of about 70 tons. The landing gear for this huge bomber can be lowered in three seconds, and retracted in eleven seconds. Parts for this and other precision landing gears are produced by the Cleveland Pneumatic Tool Co.

The shock-absorber cylinder for the main landing gear of a B-50 bomber is shown being ground internally in Fig. 1. The cylinder is forged from S A E 4340 chromium-molybdenum alloy steel. Previous to this grinding operation, twenty-four set-ups on eight different machines are required. These operations reduce the weight of the part from 1770 pounds, as a rough forging, to 255 pounds. Carefully controlled heat-treatment provides the part with a minimum tensile strength of 180,000 pounds per square inch and a hardness of 377 Brinell.

A steadyrest is required to support the end of the 40-inch long cylinder during grinding. The operation is performed on a Heald internal grinding machine, with the work rotating at 75 R.P.M. and the grinding wheel at 5000 surface



feet per minute. From 0.040 to 0.050 inch of stock is removed from three different diameters in the bore of the part, requiring about four hours to complete each cylinder. The largest internal diameter of the cylinder is finished to from 10.875 to 10.873 inches.

The grinding wheel employed for this operation is 8 inches in diameter by 3 1/2 inches wide, 60 grain, L grade, 5 structure, with a vitrified bond. A flood of soluble oil is used as the cutting fluid. By carefully controlling the cutting action at the completion of the grinding cycle, and sparking out, a surface finish of 20 micro-inches r.m.s. is obtained.

The same shock-absorber cylinder is ground externally on the Landis 24- by 168-inch cylindrical grinding machine seen in Fig. 2. From 0.035 to 0.040 inch of stock is removed from the diameter in a two-hour grinding cycle. The external diameter of the part is maintained within $\pm$ 0.0015 inch of the desired 12.0050 inches. The work is rotated at 75 R.P.M., while the speed of the wheel is maintained at 6000 surface feet per minute. The grinding wheel is 36 inches in diameter by 4 1/2 inches wide. It is made of aluminum-oxide abrasive, 54 grain, I grade, 12 structure, with a vitrified bond.

The gland-nut ends of the shock-absorber cylinders have threads ground from the solid stock on an Ex-Cell-O thread grinding machine, Fig. 3. This machine can produce precision threads on work up to 68 inches long. The single, right-hand thread of 11 1/2 inches diameter and 8 threads per inch is a Class 3 thread. The production time for grinding this thread is one hour per cylinder. An aluminum-oxide grinding wheel, 14 inches in diameter, having a resinoid-bonded abrasive of 100 grain size, K hardness, and 4 structure is employed. Similar machines are used for grinding threads on other landing-gear parts, pistons, and sleeves.

Trunnion arms of the Aerol shock-absorber

Fig. 1. Internal grinding of shock-absorber cylinder for main landing gear of B-50 bombers. The cylinder is 40 inches long and the bore is 10.875 inches in diameter

cylinders for Douglas C-74 cargo airplanes, are flash-welded in a spectacular operation performed on the 800-KVA Taylor-Winfield machine shown in Figs. 4 and 5. A weld is made on each leg of the cylinder, as seen in Fig. 4, where the part is shown after welding, with the clamping dies of the fixture open.

The parts to be welded are held on their outside diameters in the split dies of the welding fixture. An upset of 11/16 inch is effected by exerting a pressure of approximately 18,000 pounds per square inch on the parts. The automatic flashing cycle takes 129 seconds. This shock-absorber cylinder is also made from a chromium-molydenum alloy steel that is heat-treated to obtain a tensile strength of 180,000 pounds per square inch.

The world's largest bomber—Consolidated-Vultee's B-36—can carry an atomic bomb to any inhabited region in the world and return to its base without refueling. Having a wing span of 230 feet and a length of 163 feet, this huge bomber weighs 139 tons. Four-wheel, truck type landing gears are employed to distribute the weight evenly on the landing strip. The main columns of the landing gear for this airplane are shown being machined in Fig. 6.

These main columns are made from a chromium-nickel-molybdenum alloy steel, heat-treated before machining to obtain an ultimate tensile strength of from 205,000 to 220,000 pounds per square inch. Both sides of the lower terminal lugs are faced, and the holes in these lugs are bored on the Giddings & Lewis horizontal planer type boring mill shown. About 3/8 inch of stock is faced from each side of the lugs, and approximately 1/2 inch of stock is bored from the hole diameters. The diameters of the holes are main-

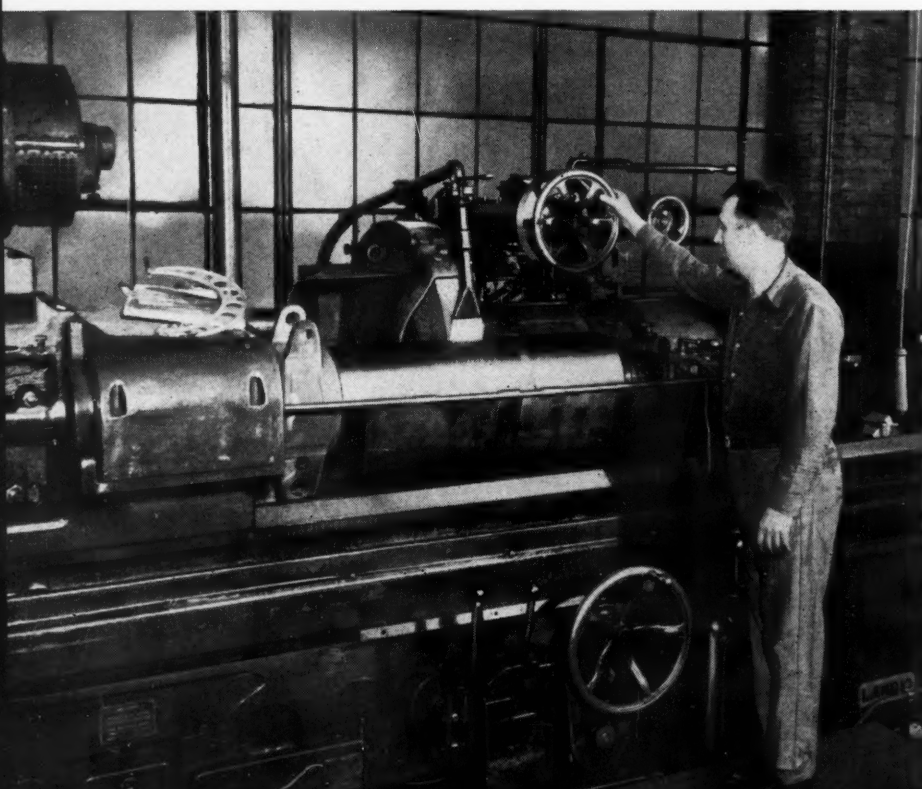


Fig. 2. From 0.035 to 0.040 inch of stock is removed from the external diameter of the shock-absorber cylinder during a two-hour grinding cycle

Fig. 3. *Threads are ground from the solid stock on the gland-nut end of the shock-absorber cylinder with the set-up shown*

Fig. 4. *Two welds are made on the shock-absorber cylinders, one on each arm of the trunnion. Clamping dies are shown open*

tained within ± 0.001 inch of the desired size—5.501 inches. It requires about 8 1/2 hours to set up and machine each lower end terminal.

Accessory attachment lugs on these landing gear columns are gang-milled on the Sellers horizontal boring mill seen in Fig. 7. Two lugs are milled from the solid stock, forming a dimension of 1.252 inches, ± 0.001 inch, between the lugs. Approximately 1/4 inch of stock is removed from the outer faces of the lugs. Both roughing and finishing cuts are necessary. The total time required to complete this operation on each column, including the setting up of the work, is 4 1/2 hours.

A huge one-piece piston and axle for use with an aircraft tire 96 inches in diameter by 36

Fig. 5. *Trunnion arms of the shock-absorber cylinders for C-74 cargo airplanes are flash-welded in a 129-second cycle on an 800-KVA machine*

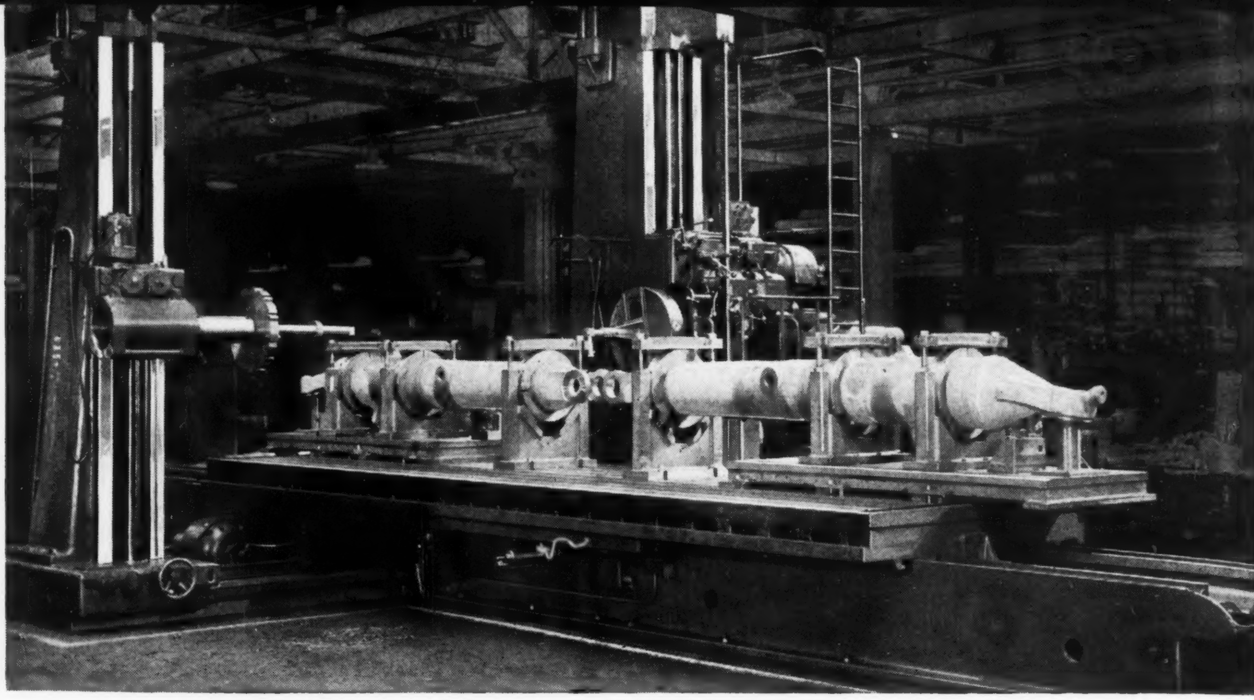


Fig. 6. Lower terminal lugs on the main columns of the landing-gear shock struts for the B-36 bomber are faced and bored in this set-up

inches wide is shown in the heading illustration being turned on a large turret lathe. This big Libby lathe, one of the largest of its type in existence, can swing parts up to 161 inches in diameter. The headstock and bed of the lathe are separated by a pit provided in the floor. A counterweight is mounted on the faceplate to offset the centrifugal force caused by the heavy part being off balance. Boring-bars up to 60 inches long are required for some of the parts machined on this lathe. When originally forged, the part shown weighed about 15,000 pounds. Its finished weight is only 581 pounds.

Careful and frequent inspection is an essential requirement of high-quality landing-gear production. Both Magnaflux and Zyglo inspection processes are employed in this plant, the former being a non-destructive method of detecting defects in magnetic materials, while the latter is a similar method of testing parts that are non-magnetic.

The equipment described in this article covers relatively few of the many types of machine tools required for the manufacture of landing gears. Some individual landing-gear parts necessitate as many as sixty operations.

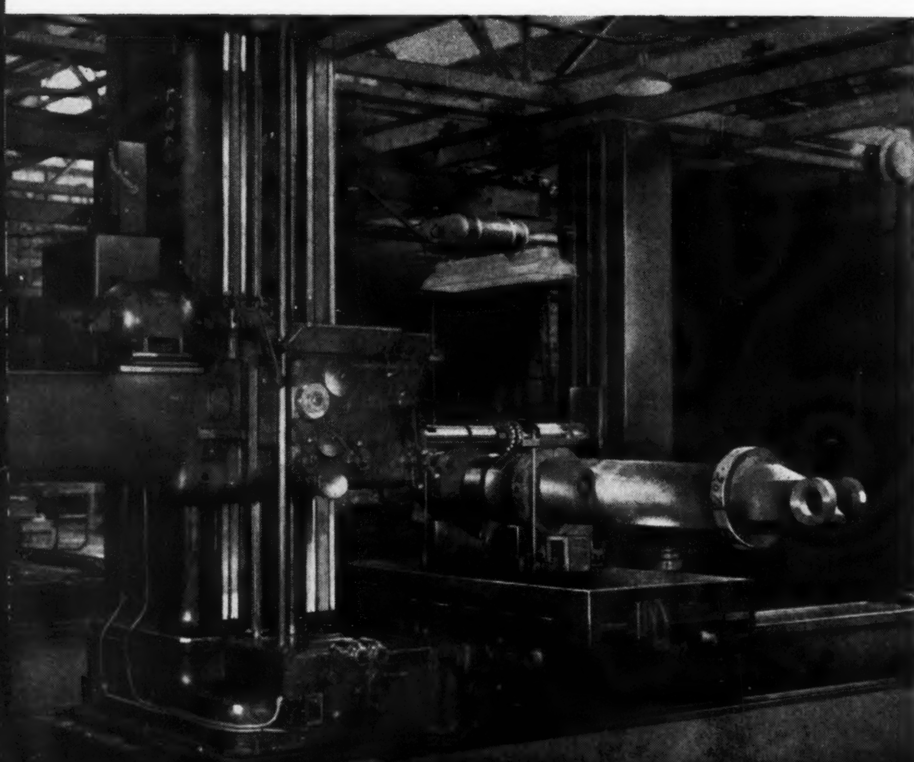


Fig. 7. A gang milling set-up on a large horizontal boring mill is employed to machine accessory attachment lugs from solid stock on main landing-gear columns

The Realms of Fantasy Require Practical Production Methods

EVER since its inception, the aircraft industry has been confronted with almost superhuman challenges. When World War II started, our military authorities insisted that the speed of fighter planes be stepped up from around 300 miles an hour to over 500 miles an hour. Before the war ended, many manufacturers had to change over to jet planes—the most radical development in aviation circles since the time of the Wright brothers' first flight.

In the post-war period, the developments have been even more revolutionary. Today, the aircraft industry is responsible for the production of flying machines that travel at speeds which can scarcely be imagined — speeds of over 3000 miles an hour for rocket planes and up to 20,000 miles an hour for satellite missiles. Truly, the technological projects of the industry have entered the realm of fantasy.

The advances in aircraft design are, however, not the only problems of the industry. With every improvement in plane design comes the job of producing aircraft components with physical characteristics capable of withstanding the extreme operating stresses and temperatures occurring at speeds in the supersonic sphere. The need for engine materials capable of withstanding the elevated temperatures has been largely met through the application of precision casting and forging methods. Some components thus produced have such high physical characteristics that they are practically unmachinable. These parts are made to such close tolerances that they require only grinding on a few surfaces to prepare them for assembly.

Many of the important components of jet engines are constructed of sheet metal, and these parts must be produced to an accuracy that is unprecedented for this type of material. Heat-treatment of jet-engine parts has also assumed increased importance.

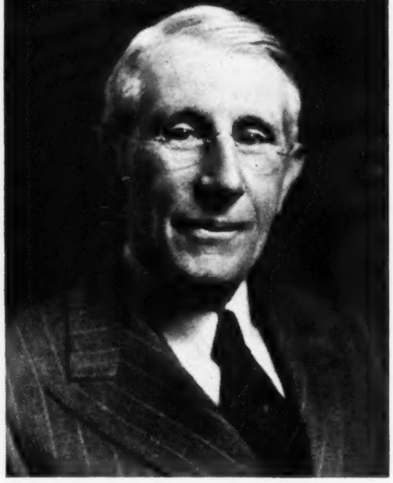
Heavy restrictions are placed on the dissemination of knowledge pertaining to the manufacture of jet engines, rocket planes, guided missiles, and the latest types of aircraft because of the international situation. Certain manufacturing operations cannot be described in the technical press, as such descriptions would disclose secret details of important parts. Nevertheless, by confining descriptions to unrestricted parts, MACHINERY'S editors have succeeded in obtaining comprehensive articles dealing with the methods being applied by the aircraft industry to today's manufacturing problems. Some of these articles are presented here.

MACHINERY'S Tenth Aircraft Production Number salutes the production men of the aircraft industry and the engineers of the machine tool, steel-making, press-building, and die- and tool-making companies, whose successful pooling of their efforts has kept American aircraft building in the forefront.

Charles O. Herb

EDITOR

American Gear Manufacturers Hold Thirty-Third Annual Meeting



(Left to right) F. W. Walker, newly elected president of the American Gear Manufacturers Association; Leroy Brooks, Jr., vice-president of the Association; and Allan H. Candee, who was presented with the Connell Award in recognition of his many valuable contributions to the gearing industry's technical knowledge and literature over the last three decades

ATTENTION was focussed on business economics and gear standardization at the thirty-third annual meeting of the American Gear Manufacturers Association, which was held at Hot Springs, Va., June 6 to 8, inclusive. The complexities of business economics were discussed by A. C. Farmer, assistant to the vice-president, Westinghouse Electric Corporation, Sharon, Pa., who pointed out that one of the basic difficulties with which business men today have to contend is the lack of a method, recognized and accredited as sound, for forecasting general business activity.

The speaker stated that, after studying this problem for years, he had reached the conclusion that there is a basic factor in the problem, and that the difficulty in forecasting results arose from overlooking this factor. He mentioned that the factor could be described briefly as the changes that take place from time to time in the volume of money in the economy.

By means of charts, the speaker explained the causes for changes in the volume of money and how they operate; traced the changes in prices and business activity relative to changes in the volume of money; showed how these changes in the volume of money are responsible for the business booms and depressions; and finally pointed out that, by anticipating the changes likely to occur in the volume of money, it is possible to anticipate the changes that will occur in the index of prices and the index of business activity.

(c) Bachrach

Roger B. Salinger re-elected treasurer of the American Gear Manufacturers Association

Mr. Farmer expressed the belief that the outlook for general business is a great deal better than is commonly supposed, and cautioned that the possibility exists for a violent inflation of both money and prices in the early fifties.

A learned paper treating of the philosophy of standardization was read by W. P. Schmitter, chief engineer of the Falk Corporation, at a symposium on standards. Other papers were presented at this session by S. L. Crawshaw of the Western Gear Works; J. H.

Hunt of the General Motors Corporation; L. D. Price of the National Electrical Manufacturers Association; and W. L. Schneider of the Falk Corporation, who served in the capacity of moderator.

An engineering paper on the subject of gear motors was presented by Howard Bennett of the General Electric Co. The speaker at the annual dinner was Gene Flack, general sales manager and advertising manager of Sunshine Biscuits, Inc. Entertainment was provided by the Westinghouse Quartet.

An important event at the annual dinner was the presentation of the Edward P. Connell Award to Allan Harry Candee of the Gleason Works, in recognition of his many valuable contributions to the gearing industry's technical knowledge and literature over the last three decades. Mr. Candee holds more than thirty patents on methods, machines, and tools for generating gears, and is the author of numerous engineering society papers and magazine articles dealing with the subject of gearing.

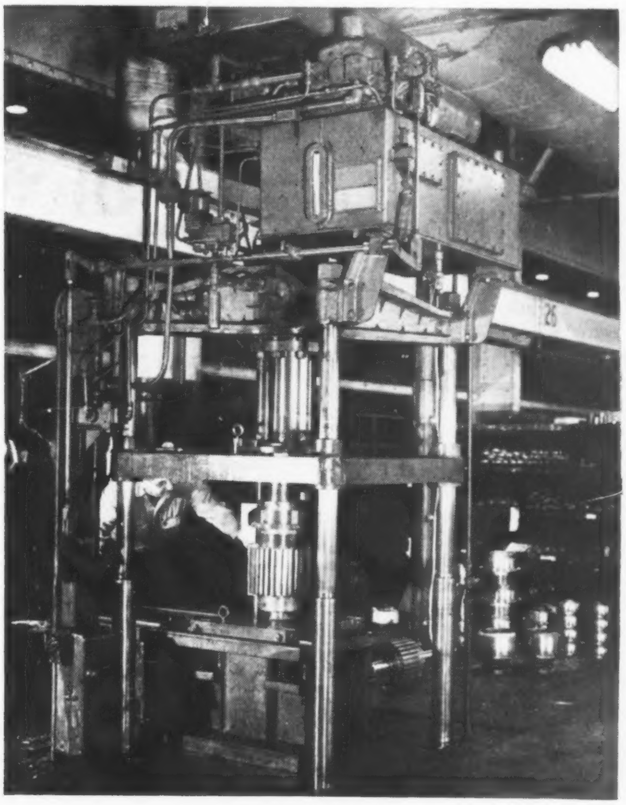
F. W. Walker, executive vice-president of the Philadelphia Gear Works, Inc., Philadelphia, Pa., was elected president of the Association for the year 1949-1950, after having served in the capacity of vice-president during the past year. Leroy Brooks, Jr., president of the Tool Steel Gear & Pinion Co., Cincinnati, Ohio, was elected vice-president, and Roger B. Salinger, president of the Massachusetts Gear & Tool Co., Woburn, Mass., was re-elected treasurer.

The following were elected members of the executive committee for terms of office that will terminate June 30, 1952: George H. Sanborn, chief field engineer of the Fellows Gear Shaper Co., Springfield, Vt.; George H. McBride, sales manager, Nuttall Works of the Westinghouse Electric Corporation, Pittsburgh, Pa.; Paul W. Christensen, president, Cincinnati Gear Co., Cincinnati, Ohio; and Robert B. Moir, vice-president and chief engineer, Foote Bros. Gear & Machine Corporation, Chicago, Ill.

* * *

Technical Service Available to Users of Tin

The Tin Research Institute, London, England, announces the formation of an American affiliate, Tin Research Institute, Inc., with headquarters at 492 W. Sixth Ave., Columbus 1, Ohio, which will provide free technical service to consumers of tin in the United States. A sponsorship will be maintained at Battelle Memorial Institute to handle new research work. Technical experts are available for consultation and assistance either at the Institute's office or at the plants of the consumers.



One of four Baldwin hydraulic presses, of 75 tons capacity each, which have been installed in the East Pittsburgh plant of the Westinghouse Electric Corporation for press work requiring precision control of loads up to 40 tons. The presses are used in assembling traction motor armatures. The illustration shows one of the presses being employed for pressing a commutator on an armature core, the operator holding a guiding templet in one hand while he moves the single operating lever with the other hand. A special table and rolling baseplate permit loading and unloading the machine with minimum physical effort

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Faster Cutting Bessemer Steel for Screw Machine Operations

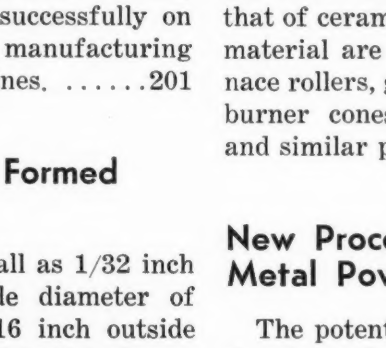
A new Bessemer steel bar stock known as USS MX free-machining steel has been announced by the Carnegie-Illinois Steel Corporation, 434 Fifth Ave., Pittsburgh 30, Pa. When used in automatic screw machine operations, MX steel provides substantially longer tool life and greatly improved surface finish of parts, with up to 20 per cent increase in machinability over standard Bessemer steel bar stock of comparable grade. The new steel has also proved to perform well in subsequent operations, such as forming or crimping. It has been used successfully on extensive production test runs in manufacturing parts on automatic screw machines. 201

Cemented-Carbide Tubes Formed by Extrusion Process

Cemented-carbide tubes as small as 1/32 inch outside diameter with an inside diameter of 0.004 inch, and as large as 9/16 inch outside diameter with a wall thickness of 1/16 inch, are now being successfully manufactured by extrusion methods in the plant of Kennametal, Inc., Latrobe, Pa. The outside diameter is rough-extruded 0.010 inch to 0.015 inch over size, and the inside diameter is held to plus or minus 1 per cent of specified size and is accurately concentric. Either thin or thick walls are obtainable by the process.

These tubes can be supplied in either of two classes of Kennametal. One is straight tungsten carbide, having the high hardness common to this material combined with unusual strength. It is suitable for parts subjected to abrasion at normal temperatures, such as wire and thread guides, orifices, nozzles, punch and die parts, gage elements, etc.

The other is essentially titanium carbide. This grade has a hardness comparable to tungsten carbide, but its weight is much less. The chief distinguishing property is that it withstands corrosion and abrasion at elevated temperatures that cause rapid disintegration of cast alloys. Its resistance to thermal shock is higher than that of ceramics. Tubes of this high-temperature material are used for such applications as furnace rollers, guide bushings for hot rods, nozzles, burner cones, thermo-couple protection tubes, and similar parts. 202



Extremely small size of cemented-carbide tubes now being extruded by Kennametal is indicated by scale. Insert shows enlargement of smallest size

New Process Provides Pre-Alloyed Metal Powders

The potential market for parts made of powdered metals has been greatly increased as a result of the introduction by the Vanadium-Alloys Steel Co., Latrobe, Pa., of alloy steel and high melting-point metal powders manufactured by a radically new process. Through this process, any metal or alloy that can be melted can be produced in powdered form. These new powders make it possible to combine the low cost of parts made from powdered metals with qualities heretofore associated only with cast or wrought metals, such as hardness, wear and corrosion resistance, resistance to softening at high temperatures, and hardenability.

Attempts to obtain the benefits of alloyed ferrous metal powders heretofore have depended upon mixing the powdered ingredients and heating for a long period to obtain an alloy by diffusion of the elements. Success has been lim-

ited, due to the extremely slow rate of diffusion, even at high temperatures. The new process provides pre-alloyed metal powders in which each particle has the complete alloy composition. Thus, every portion of the finished product will have the same chemical analysis and the same physical qualities.

Of specific industrial interest are powdered alloys of S A E 1095, 4610, and 4650, in addition to Types 301 and 316 stainless steel. Considerable experimental work with pre-alloyed S A E 4650 indicates its applicability to present-day methods and equipment in the powder metallurgy industry for the production of a variety of parts where high particle hardness is desired. 203

Chemical Stripper for Nickel and Other Metal Coatings

A compound designated "Enthone metal stripper," for chemically dissolving nickel and other metal coatings on steel without attacking the steel, has recently been developed by Enthone, Inc., 442 Elm St., Department M, New Haven, Conn. The stripper is alkaline in nature, can be contained in a steel tank, and requires no electric current. The parts to be stripped are merely immersed in a solution of Enthone metal stripper salts, in the temperature range of 160 to 180 degrees F. Stripping speed varies from 0.0002 inch to over 0.001 inch per hour, depending upon the concentration of salts and the operating temperature.

The process is stated to be especially satisfactory for removing nickel plate from bulk work, such as barrel nickel-plated steel, which previously has been impossible or difficult to strip without attacking the base metal. The steel is left in the same condition as it was prior to plating, and in most cases, the work needs simply to be dipped in acid preparatory to being replated.

The new stripping compound is also effective for removing copper plate, as well as silver, cadmium, and zinc, from steel. The solution is not suitable for removing nickel coatings from zinc-base die-castings or copper alloys. 204

Plastic Lining that Protects Drums and Tanks

Protection for drums and tanks is provided by a plastic lining recently developed by the Poly-Cyclo Products Co., Cleveland, Ohio. This product, known as Cycloflex PC-11, sets to a rugged, chemically inert membrane, and provides high resistance to corrosion and to chemical attack of inorganic acids, alkalies, water, oils, grease, oxidants, cleaners, and even the higher oxidizing reagents, such as nitric and chromic acids.

The inside of the tanks is easily observed and tools, parts, and other foreign matter accidentally dropped into tanks or drums are readily detected with Cycloflex white interlining as a background. Cycloflex is also available in high-gloss black, and, like the white lining, anneals to perfect homogeneity. Both linings withstand great fluctuations in temperature, and will not break or crack even at elevated temperatures. High bond strength, superior density, and seamless construction eliminate porosity and spot corrosion. 205

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on these pages, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in July, 1949, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on the blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

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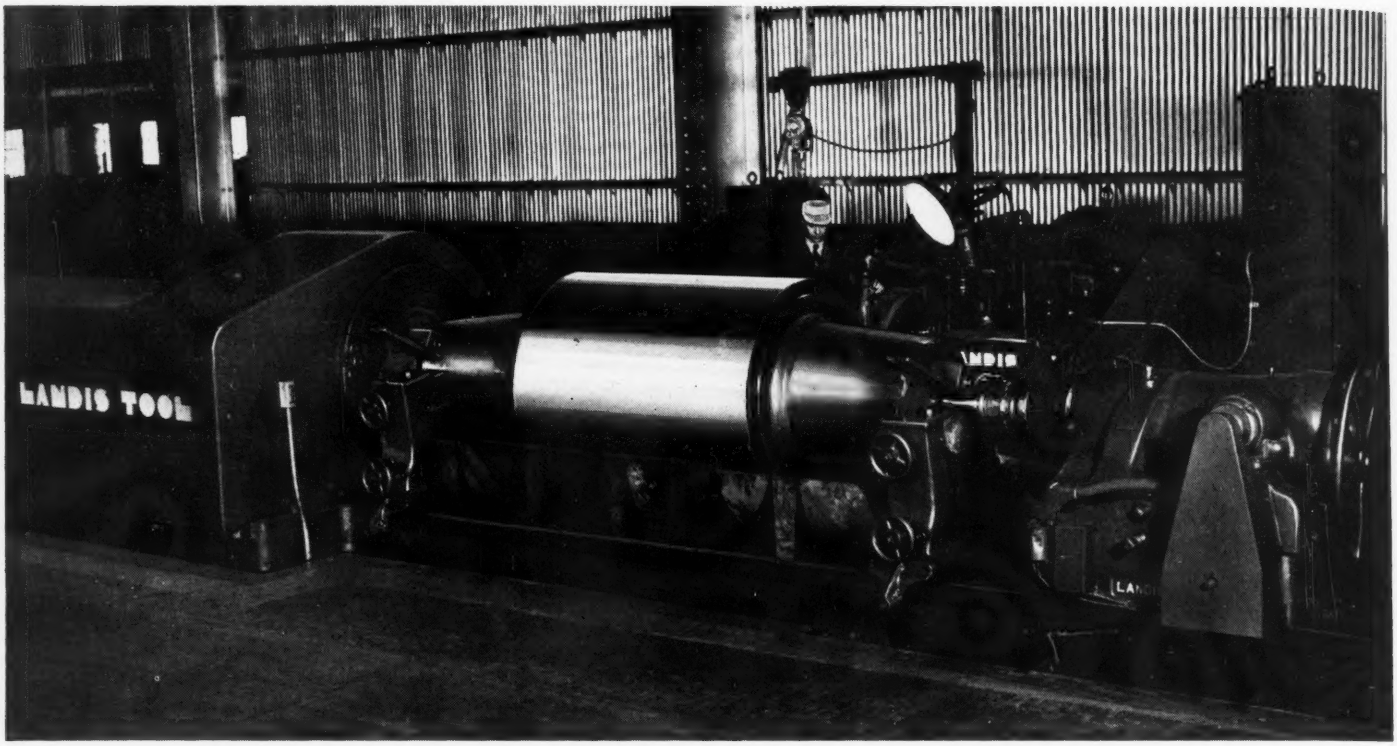
CITY .... STATE ....

New $18,000,000 Rolling Mill



Landis roll-grinding machine, employed for grinding the work and backing-up rolls of the rolling mills. The backing-up roll seen in the machine has a weight of about 65,000 pounds. The machine is equipped with a crowning and concaving mechanism

Four-high hot reversing mill equipped with "up coiling" reels on each side which are enclosed in gas-fired furnaces to conserve the heat in the steel being rolled. This is the only mill of its type in operation in the United States. It hot-finishes strip and sheet steel to widths from 15 to 50 inches and to thicknesses from 1 inch down to 0.076 inch

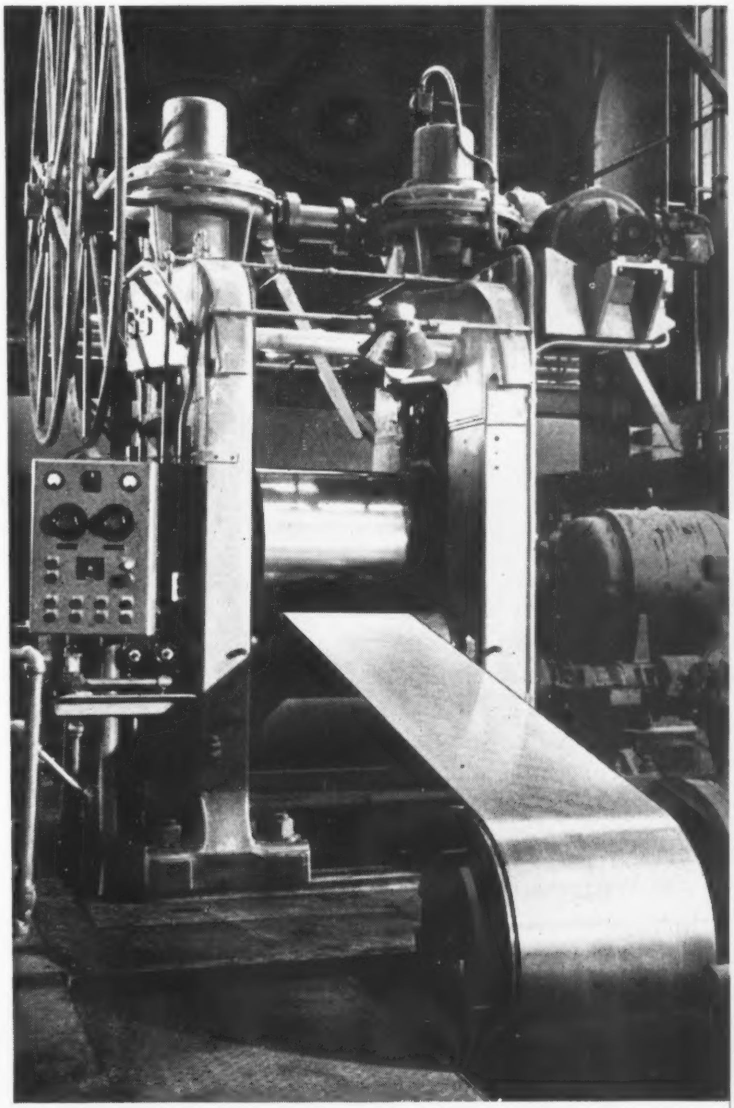
For Sheet and Strip Stainless Steel

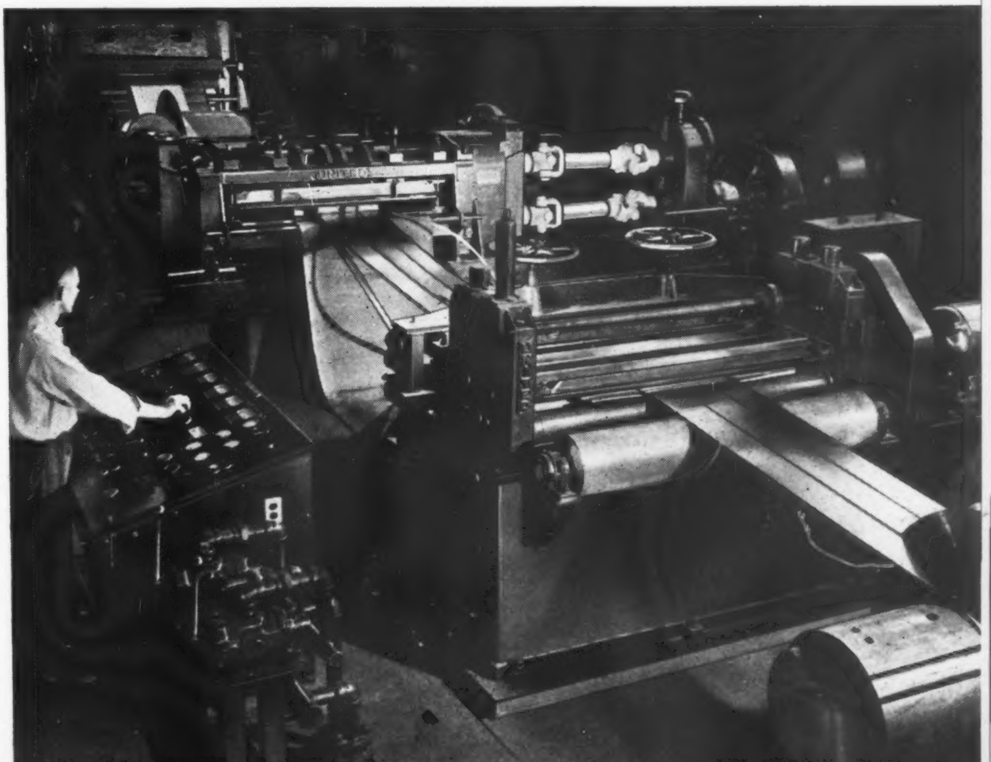
A MILL designed throughout for the hot- and cold-rolling of sheet and strip stainless and special alloy steels was recently placed in operation at the Midland, Pa., works of the Crucible Steel Co. of America. One of the outstanding features of this $18,000,000 mill is a 66-inch four-high reversing mill, provided with drum type coilers that are housed in gas-fired furnaces on each side of the mill to conserve the heat in the steel being rolled. Strip has been rolled in this mill to thicknesses from 1 inch down to 0.076 inch, and in widths from 15 to 50 inches, but the mill can be tooled up for greater reductions and widths. The mill can be operated at a rolling speed of 1200 feet per minute.

The first mill in the hot-rolling line at the new plant, which is of the two-high type, with a 32-inch diameter by 72-inch wide roll, is used for scale-breaking and for cross-rolling of slabs. Operating in conjunction with this mill is a two-high edging mill with vertical rolls, which reduces the sides of ingots to the desired width. A slab shear next cuts the steel slabs to specified lengths and crops the rough sections of the slabs before the four-high reversing mill.

After the steel strip leaves the reversing mill, it goes to a hot strip "up coiler," provided with a 25,000-pound capacity "up ender," which turns the coils on end for conventional handling along a conveyor. The annealing and pickling lines are of latest design.

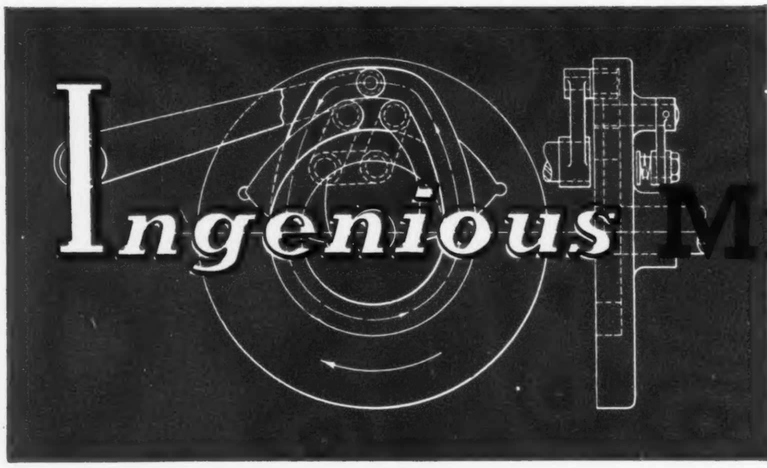
The cold-rolling department possesses what is believed to be the first tandem cold-rolling mill constructed for stainless steel.





(Above) Temper or "skin" finish mill which cold-rolls strip steel to thicknesses as small as 0.008 inch. This mill operates at a maximum speed of 200 feet a minute

(Right) Slitting equipment in the new Crucible sheet and strip mill, which consists of an uncoiler and leveler (seen in the background), a 60-inch knife shear which cuts the strip to desired length, and a rotary slitter equipped with four 15 1/2-inch knives



Ingenious Mechanisms

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and other Devices

Geneva-Wheel Mechanism for Obtaining Intermittent, Reversible Rotation

By E. L. WESTDAL

Intermittent rotation, with means for reversing the direction of rotation when desired, is provided by the mechanism shown in the accompanying illustration. Referring to the drawing, the vertical shaft *K* is driven at the same speed as the drive-shaft *A* through the medium of a pair of bevel gears *B* having a ratio of 1 to 1. The shaft *A* also drives the disk *C*, in which a pin *D* is mounted.

Pin *D* fits into the radial slots of the Geneva wheel *E*, which are spaced 72 degrees apart. Thus, for each revolution of shaft *A*, wheel *E* is indexed through one-fifth of a revolution by pin *D*. Gear *F*, which is fixed to wheel *E* and rotates on the same shaft *L*, has sixty teeth of 24 pitch. Pinion *G*, having twelve teeth of 24 pitch, which meshes with gear *F*, is therefore driven intermittently through one revolution for each revolution of driving shaft *A*.

The direction of rotation of shaft *H*, on which pinion *G* is mounted, can be reversed by bringing gear *J* into mesh with pinion *G*. This angular movement disengages gear *F* from pinion *G*, as both shafts *L* and *M* are mounted in bracket *N*, which pivots about driving shaft *A*.

Intermittent and Reversible Rotation of Shaft H is Obtained from Driving Shaft A by Means of Geneva Wheel E and Gearing

Tool Engineering Ideas

Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Boring Fixture that Eliminates Need for Scraping Operation

By ROBERT MAWSON, Providence, R. I.

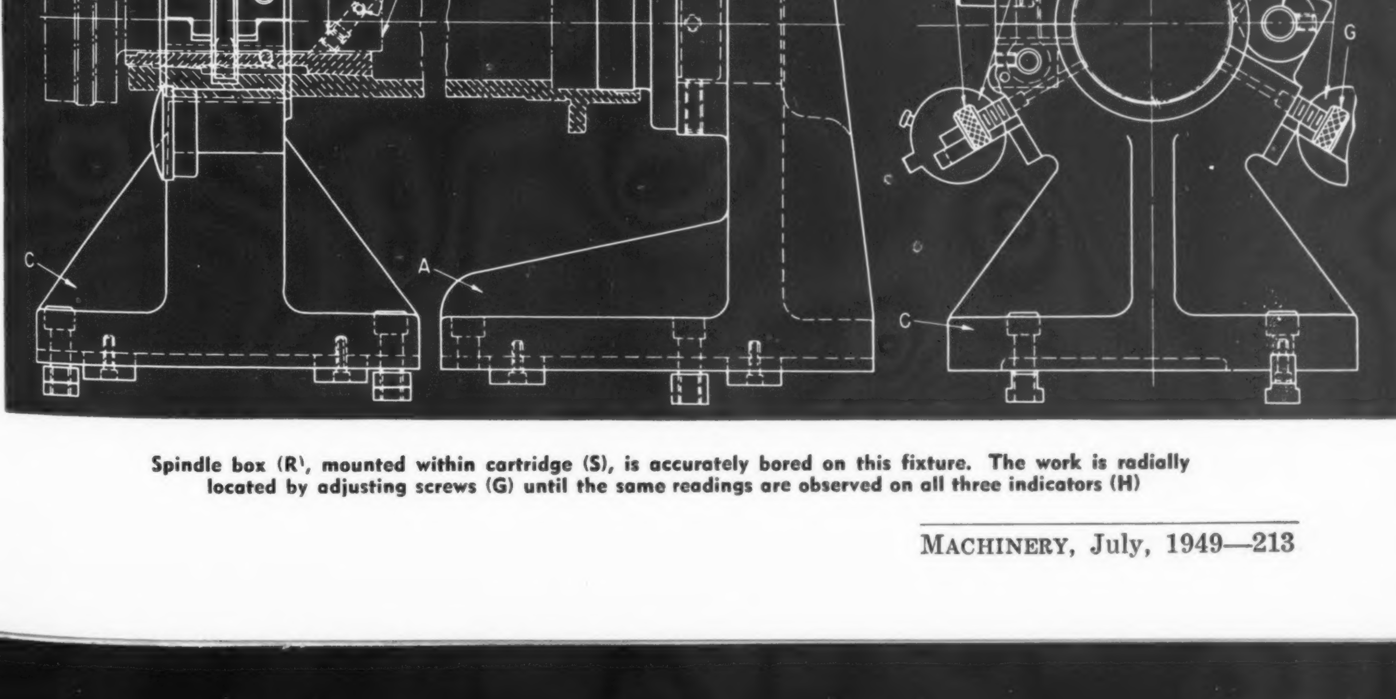
Production standards for operations performed by hand cannot always be included in manufacturing cost standards because of the variation in time required for such operations. Limiting of hand work to a minimum will permit closer estimates of the cost of a product, and, in general, will reduce the cost of manufacture. Hand-scraping of the bore in a spindle box used on a surface grinder manufactured by the Abrasive Machine Tool Co., East Providence, R. I., was eliminated by the design of the boring fixture illustrated.

The phosphor-bronze spindle box *R* is accurately fitted in Meehanite spindle-bearing cartridge *S* prior to the final boring operation. Since the spindle-box bore is 5 3/8 inches long and its diameter has to be maintained within 1.62495 and 1.62500 inches, hand-scraping was a tedious and slow job, even for a skilled workman. With the fixture shown, the assembly is accurately bored, and a fine surface finish is produced, at a much lower cost.

The fixture includes two cast-iron brackets *A* and *C*. Steel keys are provided on the bottom of the brackets to fit slots in the table of a Heald Bore-Matic machine. Both brackets are bored at assembly to insure accurate alignment of the work with the spindle of the machine, and then bolted to the table.

A hardened steel locating plug *B* is held in bracket *A* by means of oval-point set-screws *P*. Socket-head safety screws *Q* are used to bind the set-screws in position. With this method of mounting, various locating plugs can be used in the fixture to bore different sized assemblies. The locating diameter of the plug is machined to a sliding fit in the bore of the spindle-bearing cartridge *S*.

Before the boring operation, it is necessary to accurately align the locating plug with the bor-



Spindle box (R), mounted within cartridge (S), is accurately bored on this fixture. The work is radially located by adjusting screws (G) until the same readings are observed on all three indicators (H)

ing-bar *L*. This is accomplished by clamping a test bar equipped with a dial indicator to the boring-bar. The bar is rotated and set-screws *P* are adjusted until the plug is concentric with the bar and axial alignment is attained.

The upper portion of bracket *C* is machined to accommodate a cast-iron leaf cover *D*. This cover can be swung about pin *E*, which is held in the hinged portions of the bracket and cover. The cover is clamped in the machining position shown by a hinged bolt and nut *F*. Three holes for knurled-head screws *G* are drilled and tapped radially in the cover and bracket. The oval points of these screws support the spindle bearing cartridge on its ground periphery.

Dial indicators *H* are held on three machined pads by means of brackets *J*, so that the indicators can be rotated into the best position for reading. Tool-steel extensions *K* are provided on the lower ends of the standard indicator spindles to contact the ground periphery of cartridge *S* and permit radial location of the work. Screws *G* are tightened or loosened until the same reading is observed on all three indicators.

Boring-bar *L* is made from hardened and ground S A E 4150 steel. The pilot and flange faces of the bar, which are used for locating in the Bore-Matic head, are lapped to insure parallelism and concentricity. A round high-speed steel tool bit *M* is inserted in a hole reamed at an angle of 40 degrees with the axis of the bar. Set-screw *N* is provided behind the tool bit for adjustment, and set-screw *O* is used to clamp the bit in the cutting position. The bar is rotated at 3000 R.P.M., the table is fed at 1 inch per minute, and 0.005 to 0.008 inch of stock is removed from the bore diameter in this operation.

Locking Wedges Reduce Die Breakage in Hardening

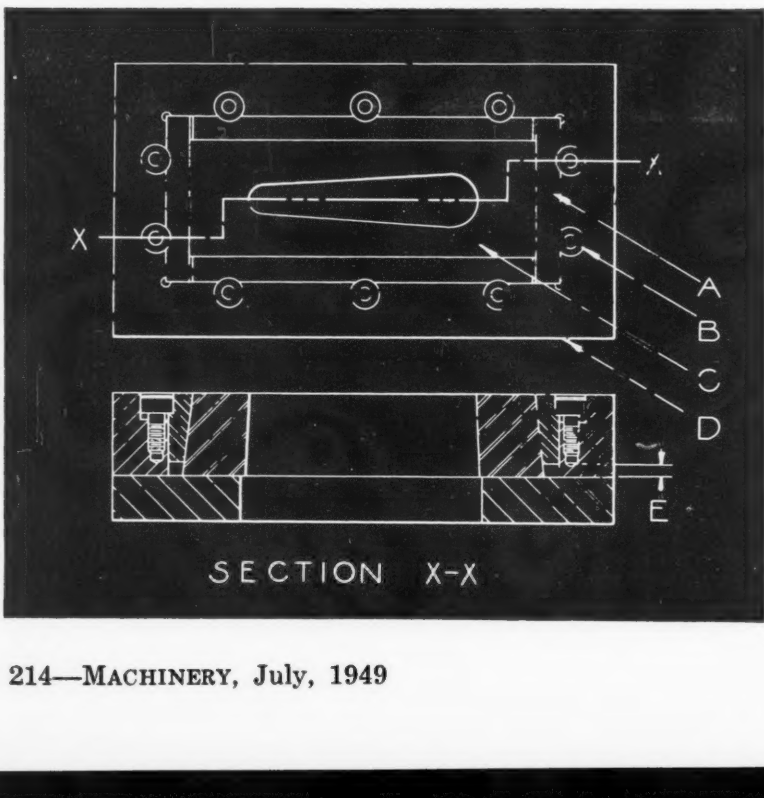
By P. E. REDGRAVE
St. Catherines, Ontario, Canada

In designing dies when space is limited and it is necessary to put screw- and dowel-holes close to each other, thin sections result. Inasmuch as these thin sections cool faster than larger adjacent sections during the quenching operation in heat-treating, internal strains are set up that tend to crack the die. To prevent this trouble, wedges with a 5-degree taper, as shown in the illustration, can be used to hold die inserts in a die-block and avoid the need for screw- and dowel-holes in the die.

Considerable holding force is obtained with the construction shown. It will be noted that four wedges *A*, clamped by means of socket-head cap-screws *B*, securely hold the die insert *C* in the block *D*. An efficient clamping action is provided by counterboring the die-block somewhat deeper than the length of the screw-heads and leaving a space under the wedges, as shown at *E*.

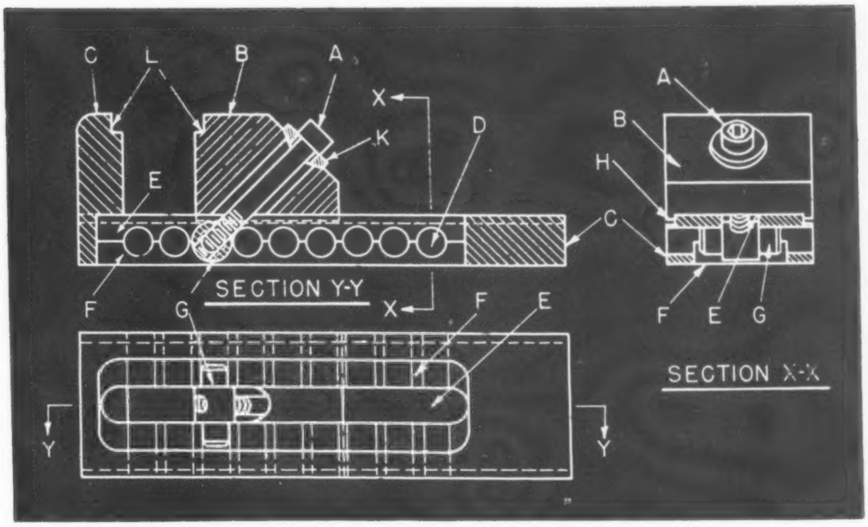
Round dies may be held in a similar manner by turning a taper on the die insert and taper-boring a suitable ring. The ring can be clamped in a casing by means of the pressure of socket-head cap-screws.

Part of the economy of this type of die-holder lies in the possibility of using one set of wedges and one die-block with several dies. By maintaining a few standard outside dimensions for the die inserts, several holders will accommodate dies with a wide range of cavity sizes, thus considerably reducing die cost.



Die securely held in die-block by means of tapered wedges. This design eliminates screw- and dowel-holes in the die

Quick - acting toolmaker's vise in which the tightening of clamping screw (A) tends to force movable jaw (B) firmly down on the base (C) of the vise



Quick-Acting Toolmaker's Vise

By CLIFFORD T. BOWER, Decatur, Ga.

A fault in many toolmaker's vises is the tendency of the sliding jaw to tilt when the work is gripped, resulting in an inaccurate and uncertain hold. The vise shown in the accompanying illustration avoids this tendency, since the clamping screw *A* tends to force the moving jaw *B* down on ways provided on base *C*. A quick-action adjustment avoids tedious turning of a screw when setting the jaws for different sized workpieces. The elimination of the standard type of screw with a ball-ended handle makes the vise a compact unit. This design of vise has proved very convenient for mounting on sine bars and plates when laying out work on the surface plate or when machining on surface grinders or drilling machines.

The fixed jaw is integral with the vise base. The base contains a series of 3/8-inch diameter holes *D*, drilled completely through its width at 1/2-inch intervals. A longitudinal slot *E* is milled in the center of the base with a 1/2-inch end-mill. Then a recess *F* is milled to a depth coincident with the center line of the drilled holes. A trunnion *G* engages one of the semicircular depressions formed by the milling process when the clamp screw is tightened. The trunnion nut drops out of engagement when the vise is lifted from the machine table and the clamp screw is slackened, thus allowing the sliding jaw to be quickly adjusted by hand.

Lugs *H*, provided along both sides of the sliding jaw, guide the jaw in steps milled in the base. A spherical-seat washer *K* is placed under the head of the clamp screw to permit swiveling when the sliding jaw is clamping the work, and the hole in the jaw through which the screw passes is enlarged to facilitate the swiveling.

Steps *L* are provided at the top of the jaws for clamping thin plates. This arrangement eliminates the need for parallel strips for supporting such work during drilling operations.

* * *

Carbide Tools Last Longer in Piano Manufacture

In manufacturing spinet pianos at the plant of the Baldwin Piano Co., Cincinnati, Ohio, three different woods—poplar, maple, and mahogany—are glued together to form the frames. These pieces are approximately 5 feet 6 inches long by 4 feet wide by 4 inches thick. The glue between the joints results in a severely abrasive action on the cutting tools in routing operations performed around the entire periphery of the frames.

The routing is done with two cutter blades held on the face of a cylindrical steel body 4 inches in diameter, the arrangement being similar to an end-mill. When high-speed steel or carbon steel blades were used, they had to be resharpened for very fifteen frames. Two solid Firthite blades measuring 1/8 inch by 3/4 inch by 5 1/2 inches were substituted. The cutterhead is now run at 7100 R.P.M. and is fed along the work at 40 inches per minute. The carbide blades last for from 250 to 300 frames between resharpenings.

* * *

Increased Sales in Gearing Industry

The gearing industry, as represented by members of the American Gear Manufacturers Association, reports an increase in sales for April, 1949, compared with March, 1949, of 13.34 per cent. The index figure for April, 1949, is 339.

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER Sales Engineering Consultant

The "Cold-Nosed Hound"

A FEW years ago, a fantastic story appeared in a monthly journal about a boastful Texas rancher and his "cold-nosed hound." The scent of this animal was so keen that it could even detect a cold trail. One day the hound treed a coon. When his master followed the trail, he found only the rotting skeleton of the animal way up in a hole in the trunk of the tree!

These are days when sales engineers must have a keen nose to detect a trail that may lead to an inquiry. Quickening our "scent" for potential business is extremely important. How can we improve this "scent"?

The answer is not only to know what is taking place in our territory, but to detect indications of what might take place. Knowing the territory is all very well, but discovering and interpreting, day by day, the signs that lead to change are vital.

Inquiries often lie hidden in such indications as these: Additions in certain types of skilled labor; contracts to be let for new construction or improvements; new investment indications; changes in, or additions to, the prospect's ultimate product; increased competition for the ultimate producer, making immediate cost reduction imperative.

Here are examples of newspaper items that have actually led to inquiries:

"Wanted: Twenty drill press operators."

This advertisement caught the eye of an alert sales engineer. "Something doing," he said. By following up this "scent," he succeeded in getting an order.

"The Wellington Metals Co. has purchased the old Jefferson Foundry on Bay St."

This notice to a keen sales engineer's eye meant business, and he found it.

"At yesterday's meeting of the Franklin Bronze Co., $100,000 was voted for plant improvements."

Such a notice as this indicated inquiries in the making.

"The Steam Equipment Co. is planning a substantial addition to its line of valves."

New designs meant new tools to an apprehending sales engineer.

"A sharp drop in profits for the last half year, due to severe competition, was just announced by the president of Metal Parts, Inc."

One imaginative sales engineer pictured here an acute need of better cost-reduction methods. Following it through, he discovered business for himself.

In these five instances, no inquiry for a machine tool existed—simply "scents" that led to a trail. An alert mind discovered the "scent." It was promptly evaluated, and with assiduous pursuit, the inquiry often assumed shape. How frequently the first sales engineer on the job with energy and helpful suggestions is rewarded with the order!

There is an added skill—some call it intuition or insight—that each one of us can further develop in selectively grasping potential sources of business. It is born in none of us, but it can be diligently cultivated.

These are, of course, just a few items of news among thousands of other press reports of human interest that are of value to the sales engineer. But a man with a keen sales sense screens them. He immediately spots and interprets certain ones as indicating specific potential prospects. He discovers the "germ" of an order. He catches a "scent." In five minutes by means of a phone call, he can often establish its significance and determine the wisdom of further action.

We can quicken our "scent" for business by cultivating our ability to scan news, just as the clever hound, ranging back and forth, can discover the live trail.

Shop Equipment News

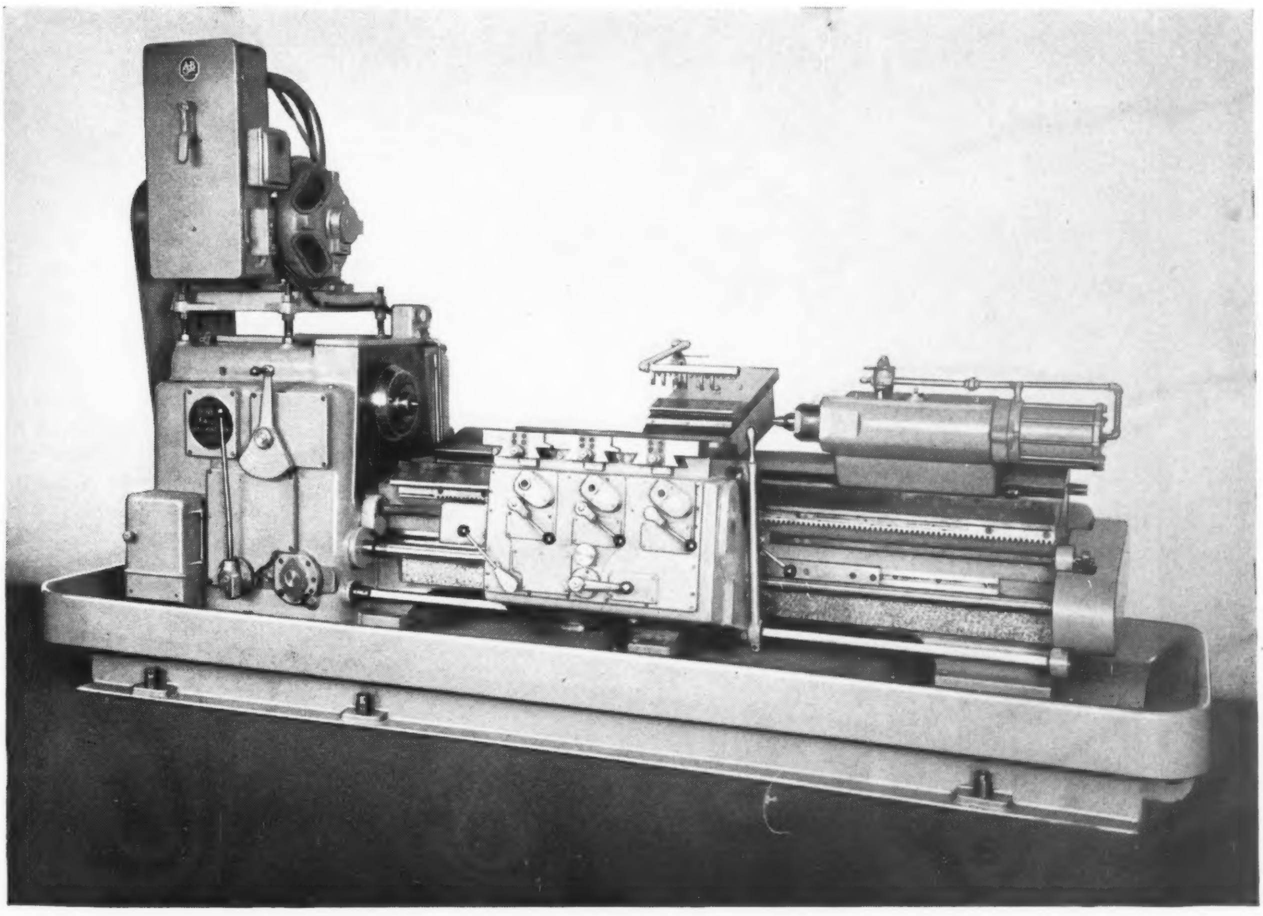
Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Seneca Falls "Lo-Swing" Lathe with Multiple-Slide Carriage

The Seneca Falls Machine Co., Seneca Falls, N. Y., has brought out a new "Lo-Swing" lathe designed to meet the demand for a high-speed multiple turning machine that can be readily set up and operated by an unskilled worker. The multiple-slide front turning carriage of this new Model AP semi-automatic lathe operates on the rack and pinion feed principle, which permits exceptionally long turning cuts. Heavy stock removal with sintered carbide tools is made possible by the balanced twin rack pinions which mesh with the heat-treated steel rack and serve to cut the unit tooth pressure developed substantially in half.

This lathe is particularly recommended for turning shafts involving long shoulder lengths where overlapping of cuts is objectionable. It is also well adapted for short-run jobs that do not justify the expenditure of time required to set up fully automatic machines. The rugged, heavily constructed carriage cross-slides of this lathe are power operated and individually controlled. Hinged type roller steadyrests are supplied to prevent the work from springing away from the tools.

Other features include automatic feed throw-out, coupled with automatic tool relief; rapid traverse movements for longitudinal carriage feed and cross-slides and for the automatic back attachment; manually operated safety feed clutch, which stops all carriage feeds in case of tool breakage; hardened steel strips on bed for carriage and on top of carriage for cross-slide ways; heat-treated headstock spindle mounted on heavy-duty ball bearings; and pulley shaft equipped with multiple-disk clutch and brake which permit continuous rotation of the motor and instant stopping of the spindle. 61



"Lo-Swing" lathe with multiple-slide carriage recently brought out by the Seneca Falls Machine Co.

To obtain additional information on equipment described on this page, see lower part of page 242.

New Micromatic "Hydrohoners"

Three new precision "Hydrohoners" and a Micromatic gage-bar "Microsize" head were introduced by the Micromatic Hone Corporation, 8100 Schoolcraft Ave., Detroit 4, Mich., at the company's recent observance of its twentieth year of developing and building precision honing machines. The Model 735 Hydrohoner shown in Fig. 1 is a precision machine developed for microhoning small-diameter parts. Its principal features are ease of operation and sensitive controls. Tolerances as fine as millionths of an inch can be held with this machine on parts that are ordinarily hand-lapped, making it possible to reduce the number of operations and selective fits on parts such as Diesel-engine injectors.

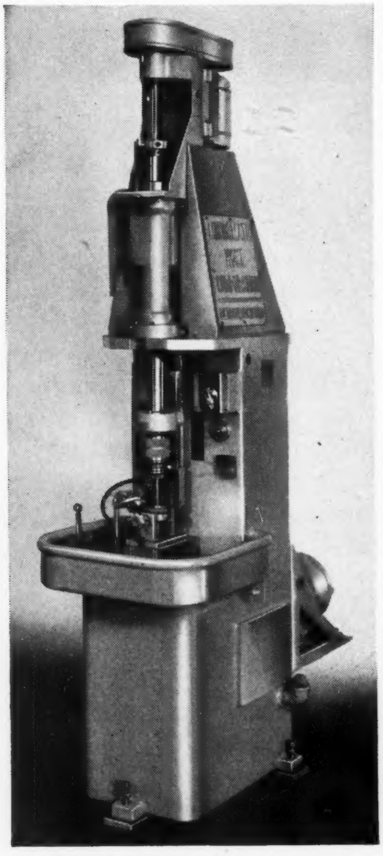
The particular machine shown is equipped for a precision finishing job on a part similar to an injector barrel which has a hardness of 45 Rockwell C. The work is held to size within 0.0001 inch on the diameter. The surface finish is 2 to 4 micro-inches r.m.s.

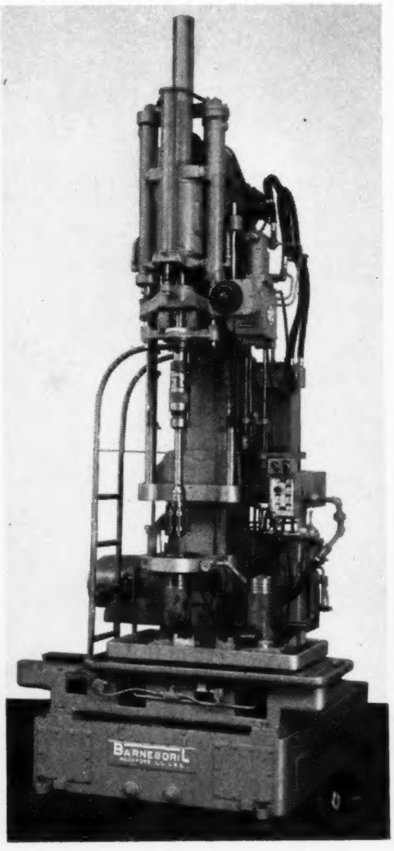
The new Micromatic gage-bar "Microsize" head and tool is shown mounted on a Barnesdril honing machine in Fig. 2. In this application, Diesel-engine liners, 5.750 inches in diameter and 15 inches long, are shown being honed and automatically sized. The size is held to a tolerance of less than 0.001 inch and the finish is 12 to 16 micro-inches r.m.s. Production is at the rate of twenty-five liners per hour, removing 0.001 to 0.005 inch of stock.

Fig. 3 shows the Model 718 general-purpose Hydrohoner designed especially for tool-room and reconditioning work. The head of this machine is reciprocated hydraulically. Inching of the head into the bore, the reciprocation speed, and the withdrawal of the head are all effected by the "Uni-Control" lever. The machine is shown with a lateral indexing table fixture designed for honing a six-cylinder automotive block. Production on these blocks is six per hour. The size is held to a tolerance of less than 0.0005 inch on the diameter. Any desired surface finish can be obtained. By mounting a riser block on the base, this machine can be adapted for honing small parts, such as connecting-rods. For this type of work, the machine is furnished with a "signal light Microsize" device, which indicates when the part has been finished to size by turning on a light at the electrical control panel.

In Fig. 4 is shown the Model 523 Hydrohoner. This automatic quill type horizontal machine is adapted for honing valve guides. The valve guides are precision finished straight and round on this machine, which holds the work to size within 0.0003 inch on the diameter. Production is 250 parts per hour.

Operation of the machine is completely automatic, the valve guides being loaded into a magazine. When each part is finished, it is ejected just as the next part is loaded automatically into the collet fixture. The quill then moves forward and another part





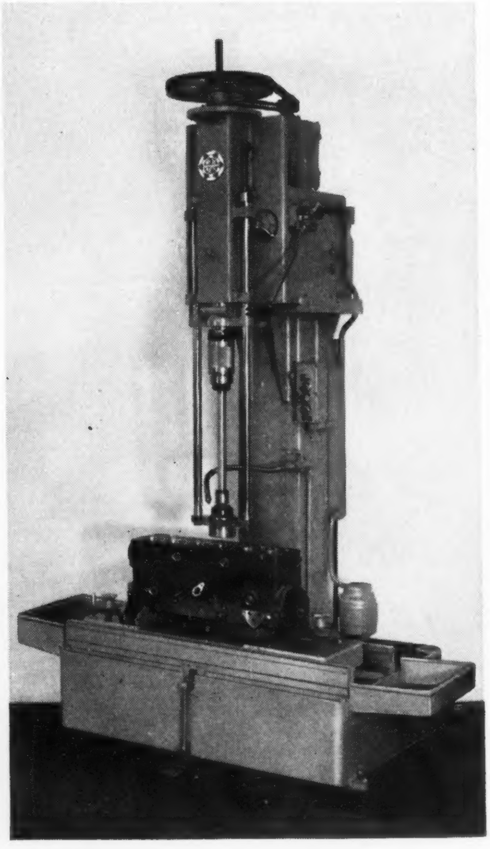
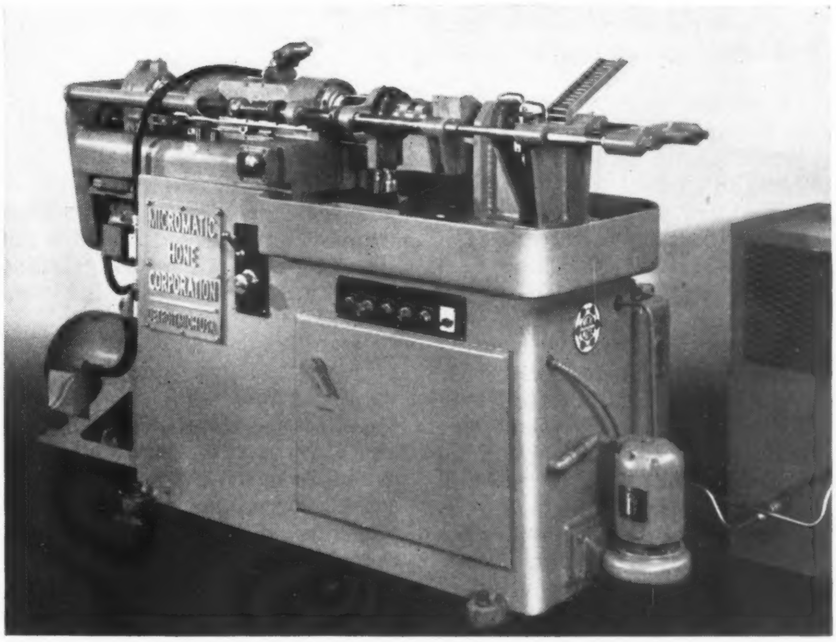


Fig. 1. (Left) Precision Hydrohoner developed for the microhoning of small-diameter parts. Fig. 2. (Center) Micromatic gage-bar "Microsize" head and tool mounted on Barnesdril honing machine. Fig. 3. (Right) Hydrohoner general-purpose honing machine announced by the Micromatic Hone Corporation

To obtain additional information on equipment described on this page, see lower part of page 242.

Fig. 4. Automatic quill type horizontal Hydrohoner adapted for honing valve guides



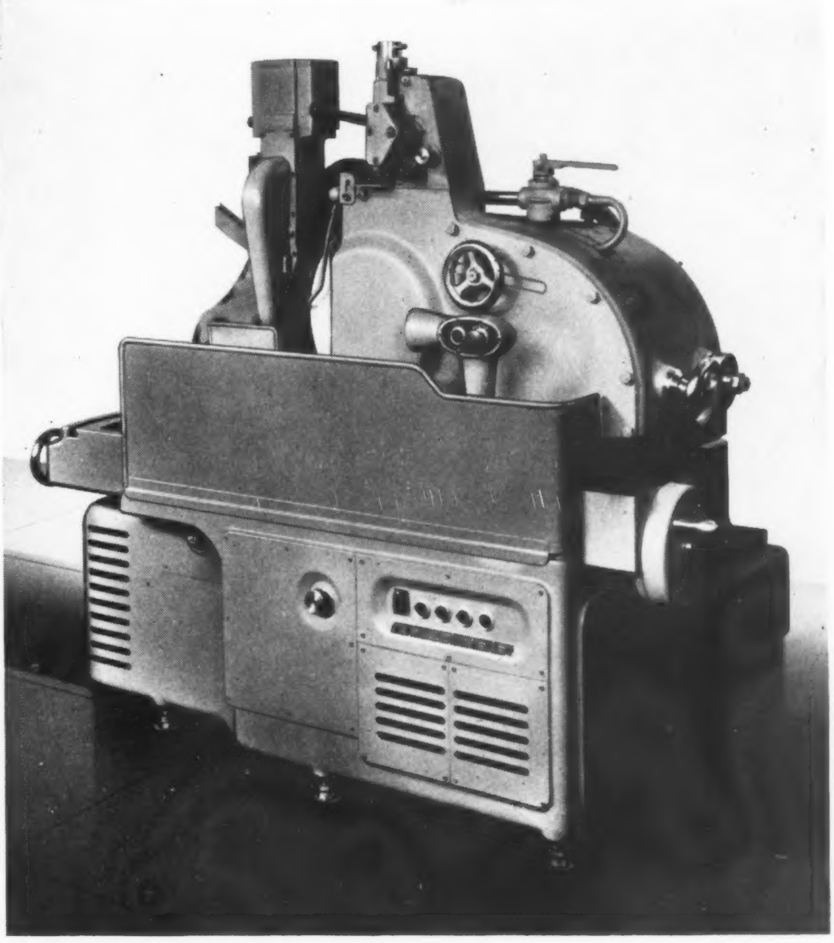
drops into the loading position. At the forward end of the first stroke, the tool starts rotating and the "Microdial" control expands the honing tool. When the bore has been finished to size, the "Microsize" control ends the cycle by collapsing the tool and withdrawing it from the bore. This motion of the head positions the next part in the fixture, and the cycle is repeated. This machine is equipped with a new "Intra-Flo" tool to insure an adequate supply of coolant to the surface being honed. The coolant flows to the inside of the honing tool and is directed on the surface being honed. 62

Cincinnati Filmatic "Micro-Centric" Grinding Machines

A new high-production grinding machine called the "Micro-Centric" has recently been developed by Cincinnati Grinders Incorporated, Cincinnati 9, Ohio. This machine, designed primarily to meet the requirements of the precision anti-friction bearing industry, can also be used for numerous parts requiring similar standards of accuracy. Employing a new principle of work support and rotation, the machine will, without centers or a chuck, easily maintain roundness limits well within 0.000025 inch. The ground diameter can also be held square with a prefinished face to an accuracy of under 0.000025 inch.

The "Micro-Centric" grinders are made in two sizes, either of which can be built for full automatic operation or for hand loading. The No. 1 machine will grind work from 3/4 inch to 3 1/2 inches in diameter, using either automatic or hand loading, while the No. 2 machine will handle pieces from 2 to 4 inches in diameter, using automatic loading, or 2 to 8 inches in diameter when employing hand loading. One operator can feed two to four fully automatic machines or one to two hand-loaded machines, depending upon the operation.

Fundamentally, the "Micro-Centric" grinders are built to handle work of large diameter relative to the length. The machines operate by a unique method wherein the grinding-wheel head, pivoting on a trunnion under the wheel-spindle, is rocked forward into the grinding position through



Front view of new Cincinnati No. 1 "Micro-Centric" grinder with coolant guards in place

To obtain additional information on equipment described on this page, see lower part of page 242.

a definite preset cycle. This cycle develops in four phases as follows: Load; rapid advance; feed and dwell; retract and unload. Each phase can be individually controlled, and each is flexible and simple to adjust. A well balanced combination of electrical and hydraulic controls insures rapid response and smooth action.

Rapid advance movement, regardless of work-piece diameter, can be varied from 0 to 1 3/4 inches and the in-feed movement is adjustable from 0 to 3/8 inch. This amount of movement provides ample clearance around the headstock when loading by hand, and also allows "air grinding" to be reduced to a minimum when fully automatic grinding operation is employed. Approximate setting of the wheel-head in the forward position is accomplished by adjusting a locked cam at the rear of the unit. This cam also serves as a positive stop for repetitive sizing. Final close grinding adjustment is made by positioning the cross-slide on which the headstock is mounted.

The combined in-feed and tarry time can be varied from three to sixty seconds to suit the material to be ground and the quality of finish required by means of an electrical time delay relay. The in-feed rate of grinding can also be varied from 0.005 to 1 inch per minute. Although these grinders are primarily in-feed machines and have no provision for traverse grinding, a grinding wheel reciprocator is available for improving quality of finish when required.

Ample power is available, the grinding wheel on the No. 1 machine being driven by a 3-H.P. motor, and that on the No. 2 machine by a 7 1/2-H.P. motor. Headstock spindles on both machines are powered by 3/4-H.P. motors, while the hydraulic pumps are driven by 1-H.P. motors.....63

Acme Semi-Automatic Tapping Machine

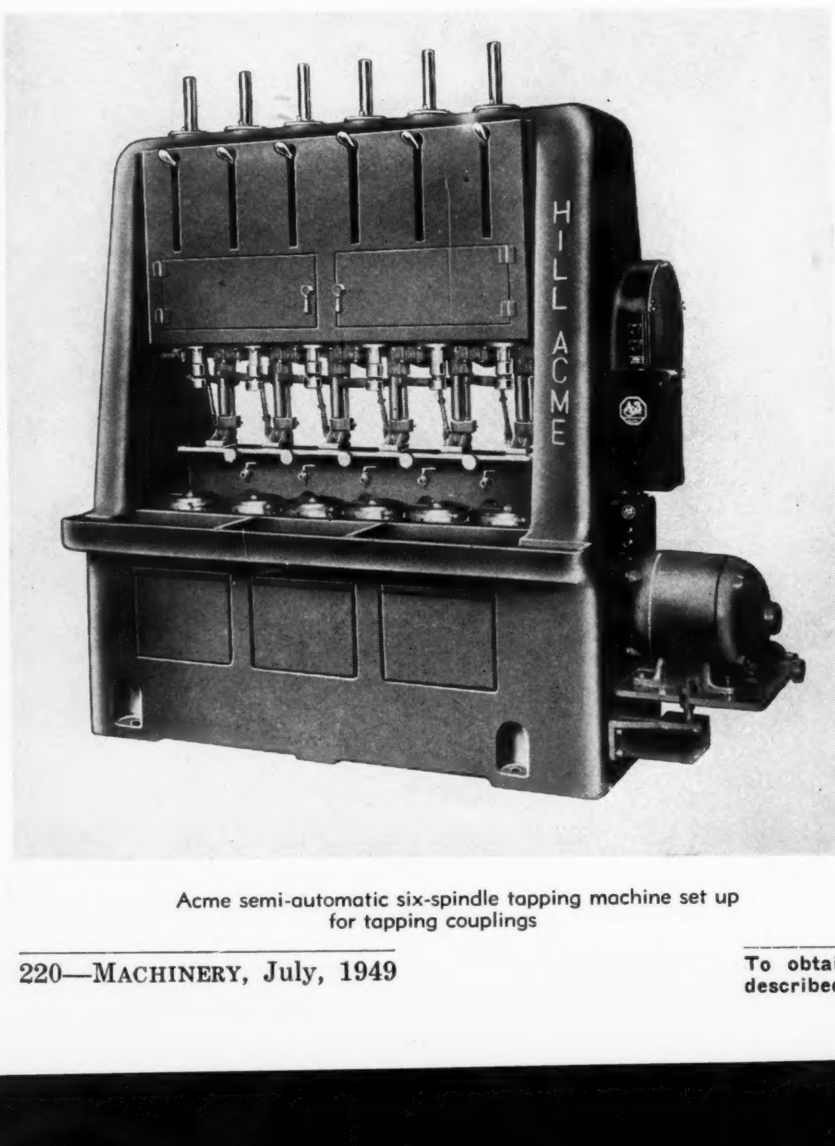
A new semi-automatic tapping machine, built in six- and eight-spindle models in standard 1- and 2-inch sizes, has been added to the line of the Hill Acme Co., Acme Machinery Division, 4535 St. Clair Ave., Cleveland 14, Ohio. Larger size machines are also being built in four- or six-spindle models. These machines have enclosed working parts and are especially designed for accurate, rapid production work.

The six-spindle semi-automatic machine shown in the accompanying illustration is equipped for tapping couplings, and can also be adapted for tapping nuts. The spindles are splined and independently operated. Each spindle is equipped for quick return to its upper position. The spindles have an 8-inch travel and are provided with an adjustable hydraulic spindle check to cushion the impact and prevent injury to the tap as the downward travel brings it in contact with the work.

In operation, the coupling is placed in the chuck and the hand-lever controlling the air valves is depressed, causing the chuck to close on the coupling. This action also permits the downward movement of the spindle, which descends by gravity. Upon completion of the tapping operation, the continued downward movement of the spindle automatically operates the air valve, causing the chuck to open and the lifting cam mechanism to return the spindle to the upper position. The tapped couplings on the shank of the tap are also carried upward with the tap.

When the shanks of the taps have become filled with tapped couplings, the taps are removed from their sockets and unloaded into chutes located between spindles which carry the tapped couplings to receptacles at the rear of the machine.

The six-spindle machine measures 96 by 50 1/2 by 95 1/2 inches, and the eight-spindle machine 115 by 51 1/2 by 95 1/2 inches. The machines are driven by 10-H.P., 1800-R.P.M. motors, and have spindle speeds ranging from 59 to 191 R.P.M. 64



Acme semi-automatic six-spindle tapping machine set up for tapping couplings

Pressure-Tight Pipe Plug

A new "Unbrako Dryseal thread" plug designed to seal pipe pressure-tight without the use of sealing compound has been announced by the Standard Pressed Steel Co., P.O. Box 22, Jenkintown, Pa. This new plug is made

To obtain additional information on equipment described on this page, see lower part of page 242.

with the "Dryseal" pipe thread originally developed for use with ammonia and other refrigerant piping systems, and is designed to eliminate leakage problems encountered in high-pressure equipment of all kinds. The unique design of the thread provides an actual crushing or sealing action at both major and minor diameters, which effectively prevents spiral leakage, even under extreme pressures. The plug is available in a full range of sizes, from 1/16 inch to 2 inches National Pipe Thread Fuel sizes. 65

Cleveland Two-Point Double-Action Toggle Press

A two point double-action toggle press of double-geared, twin-drive design, equipped with electrically controlled, air-operated friction clutch, is a recent product of the Cleveland Punch & Shear Works Co., Cleveland 14, Ohio. This press has an air counterbalance for both the inner slide and the blank-holder slide, power adjustments for the inner slide being obtained by an individual motor. The four corners of the blank-holder slide can be individually adjusted manually.

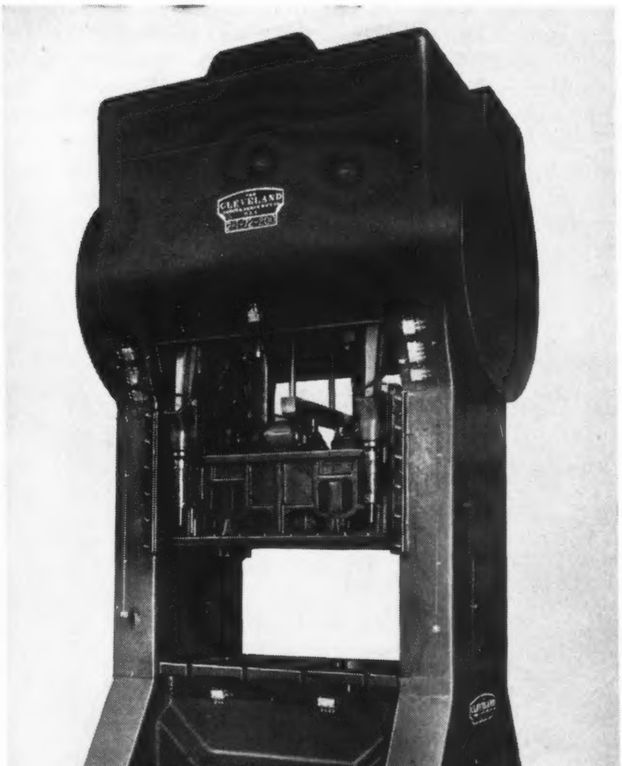
All gears and the driving unit are enclosed in the box type crown of the press, and there are no overhanging brackets or other projections. The driving links of the toggle mechanism, together with the bearings, are lubricated by a constant flow of oil under pressure. The blank-holder has an extremely long dwell of 140 degrees, which provides more clearance between the face of the slides and the dies for the removal of the stock.

The press operates at the rate of eight strokes per minute. It has a capacity of 200 tons for the inner slide and 120 tons for the blank-holder slide, and is equipped with a 35-ton pneumatic cushion operating at 100 pounds per square inch air pressure with a travel of 10 inches. The inner slide has a stroke of 23 inches, with an adjustment of 5 inches. The bed has a surface area of 45 by 72 inches. 66

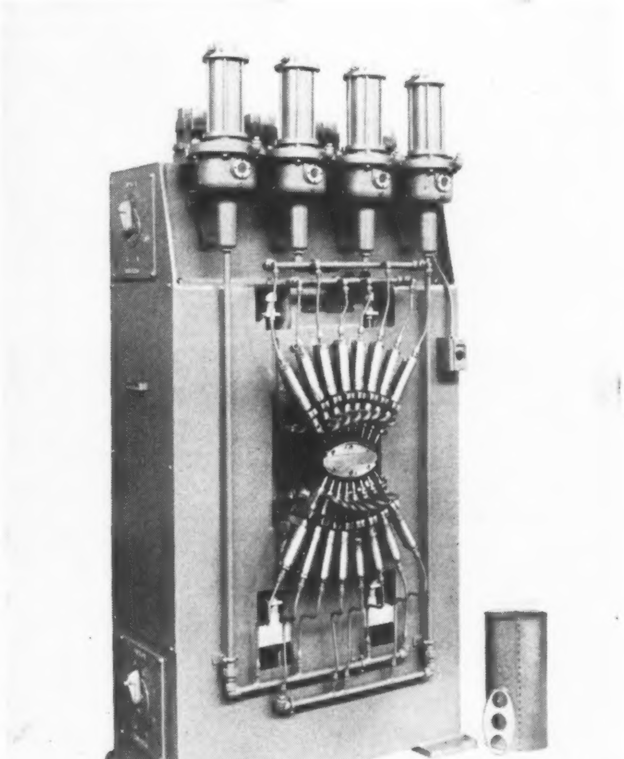
"Air-Speed" Multiple-Electrode Resistance Welder

The "Air-Speed" type of multiple-electrode resistance welder recently added to the line of the Taylor-Winfield Corporation, 1052 Mahoning Ave., N.W., Warren, Ohio, incorporates compact, hydraulically operated welding guns. The new design eliminates the need for a hydraulic pumping unit, air-oil boosters operated through air valves that work in sequence being connected with the main air supply to provide the required welding force. Each welding gun transmits welding current when a contactor, actuated by the sequencing mechanism, energizes the primary windings of the welding transformer.

The "Air-Speed" welder illustrated is equipped with two 50-KVA transformers, and is used to weld baffles in automobile mufflers made of 0.040-inch zinc-coated steel at the rate of 480 mufflers per hour. It makes sixteen welds per muffler, in four progressive groups of four welds per group, or a total of 7680 welds per hour. 67



Two-point double-action toggle press brought out by the Cleveland Punch & Shear Works Co.



"Air-Speed" sixteen-electrode welder added to the line of the Taylor-Winfield Corporation

To obtain additional information on equipment described on this page, see lower part of page 212.

Fig. 1. "Grindwell" general-purpose cylindrical grinder

Landis "Grindwell" Cylindrical Grinding Machine

The Landis Tool Co., Waynesboro, Pa., has announced a new general-purpose precision cylindrical grinding machine designated the "Grindwell." This machine was developed to make available to industry a simple, low-priced, flexible precision grinder, capable of performing a variety of grinding operations. It can be used for small-lot manufacturing purposes in large or small shops, in tool-rooms, and for training purposes. The new grinder has a capacity of 28 inches between centers and will swing work 12 inches in diameter. The 12-inch diameter grinding wheel is driven by a 1-H.P. motor.

Landis "Microsphere" bearings are used to support the wheel-spindle. These are self-aligning, babbitt-lined, one-piece steel bearings designed to absorb thrust loads. The exceptionally close running clearance of these bearings is said to result in quick, accurate response to wheel feed and to be adapted for a short, positive spark-out period. A graduated swivel base permits swiveling the wheel-head for unusual grinding set-ups or for truing an angular surface on the wheel face.

The headstock has an infinitely variable speed range of from 85 to 483 R.P.M. obtained by rheostat control. There are only two revolving parts—the motor spindle and the faceplate. Either live or dead spindle operations can be employed by simply moving a lever. The base of the headstock is mounted on a graduated swivel to facilitate setting up for angle or face grinding operations.

Power traverse is supplied, four different speeds being available through a shift lever. Two-speed hand traverse is standard equipment, a slow speed suitable for grinding fillets or shoulders, and a fast speed for setting up. The table can be swiveled for taper-grinding operations. A scale, graduated both in degrees and inches per foot, permits accurate taper settings.

The coolant reservoir is part of the bed casting, and other compartments in the bed serve to house the electrical control panel and the traverse drive motor. The electric motor equipment consists of a 1/3-H.P. motor for driving the work; a 1-H.P. motor for driving the wheel; a 1/4-H.P. coolant pump motor; and a 3/4-H.P. traverse motor. The machine requires a floor space of 51 by 105 1/2 inches, and weighs 3300 pounds, including electrical equipment...68

Carboloy Blanks for Lathe and Grinder Centers

An improved line of standardized solid carbide blanks for lathe and grinder centers has been placed on the market by the Carboloy Company, Inc., 11147 E. Eight Mile Road, Detroit 32, Mich. The length of these blanks has been increased to provide centers which will have longer life. The blanks are made in Carboloy Grade 44A only. They are supplied in seven sizes ranging from 0.250 to 0.875 inch in diameter, and are ground to size within limits of plus 0.000 inch and minus 0.002 inch. 69

Fig. 2. "Grindwell" machine set up for grinding steep taper work

To obtain additional information on equipment described on this page, see lower part of page 242.

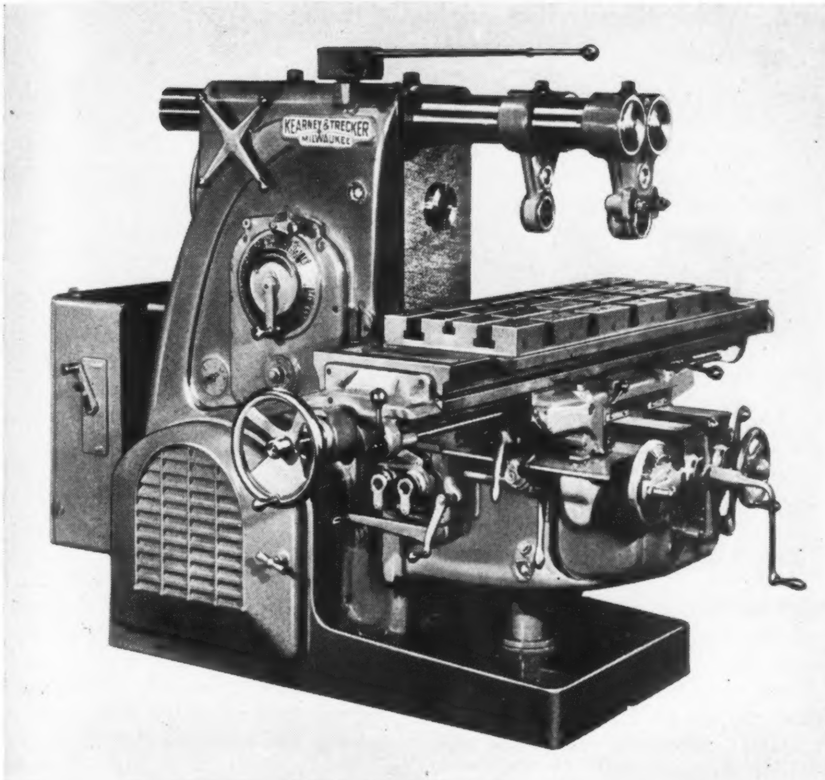


Fig. 1. Kearney & Trecker plain milling machine with recently developed chucking table

Kearney & Trecker Chucking-Table Milling Machines

A new line of knee type milling machines featuring a built-in chucking table designed to simplify work-holding problems has been brought out by the Kearney & Trecker Corporation, 6784 W. National Ave., Milwaukee 14, Wis. With the new vise jaws and standard set-up accessories, the chucking table can be adapted for handling a wide range of irregular-shaped work with a minimum of set-up time and without the need of special tools and fixtures. These chucking-table milling machines are available in twenty-four plain or vertical styles, with or without automatic-cycle "Mono-Lever" table control. Two sizes—Nos. 4 and 5—have 42- and 50-inch power table travel, respectively. Power capacities range from 20 to 50 H.P.

Noteworthy features include deep-well coolant return drain that keeps the working surface of the table free from coolant and chips; self-cleaning, accurately bored, and conveniently located holes for bumper stops; longitudinal T-slots precision-milled for positive alignment of jaw bases and jacks, the center T-slot being a standard 13/16-inch size machined to accommodate vises, rotary tables, or other accessories; metered lubrication that supplies oil to table and saddle ways and to table feed-screw through a spring-loaded piston pump; five transverse T-slots that are carefully spaced for maximum work-holding capacity within the range of the table and that provide for setting up large and small work with equal facility; and "Mono-Lever" table control for feed and rapid traverse, which greatly simplifies machine operation and reduces operator fatigue.

Included in the chucking table accessories are master jaw bases, consisting of two large T-nut units connected by a right- and left-hand screw, the end of which is squared to take a crank-handle. Three types of vise jaws are supplied for mounting on the master jaw bases to form chucking set-ups capable of handling a wide range of work. In addition to the various types of universal vise jaws, other work-holding and locating accessories are available, including an adjustable spring-loaded screw jack and a plain screw jack for mounting in the large transverse and longitudinal table T-slots, and a smaller plain screw jack for use in the small longitudinal table T-slot. 70

General-Purpose Electrode

A new general-purpose electrode, developed particularly for maintenance and production work on special steels of the high-alloy and high-carbon types, is now being placed on the market by All-State Welding Alloys Co., Inc., 273 Ferris Ave., White Plains, N. Y. This electrode, identified as All-State No. 252, has a tensile strength of 85,000 to 95,000 pounds per square inch, and high heat, corrosion, and wear resistance. 71

Fig. 2. Chucking table of machine shown in Fig. 1, set up for milling three pads on steel cast locomotive eccentric lever

To obtain additional information on equipment described on this page, see lower part of page 242.

Walsh Blank-Feeding and Work-Removing Attachment for Punch Press

The Walsh Specialty Co., Inc., 536 S. Shawnee St., Lima, Ohio, has developed a feeder designed to permit the full speed capacity of presses to be utilized in the production of laminated products. This feeder inserts the blanks and removes the punchings by positive action, without depending on gravity for the removal of the punching from the die. For example, with motor laminations, the rotor disk is punched through the die to a stacking tube, and the stator punching is pulled back out of the die with the feeder slide and then dropped onto conventional matches.

Other advantages of this feeder are that it can be swung aside easily and quickly to make die changes, and will feed and remove only one punching at a time. Thus, two or more punchings cannot be fed into the die at one time, nor can they be stacked in the die, eliminating the need for overload safety precautions.

The speed of the feeder is controlled directly by the speed of the press. It will operate up to 150 strokes per minute with mechanical linkages, and is expected to operate at much greater speeds by utilizing hydraulic linkages. Although developed to handle electric motor laminations, this feeder has numerous applications wherever blanks are fed into dies and the speed is limited by the feeding mechanism. 72

Leonard Tube-Flaring Machine Designed for Aircraft Industry

The "Tubemaster" machine here illustrated has been brought out by the Leonard Precision Products Co., Garden Grove, Calif., to meet the requirements of aircraft manufacturers for flaring, flanging, squaring, and burring either ferrous or non-ferrous tubing ranging in size from 1/8 inch to 5 inches in diameter. Adapters are furnished with the new model, so that users of the smaller capacity machines can utilize the tools and dies they now have. When required, tooling is also available for beading operations.

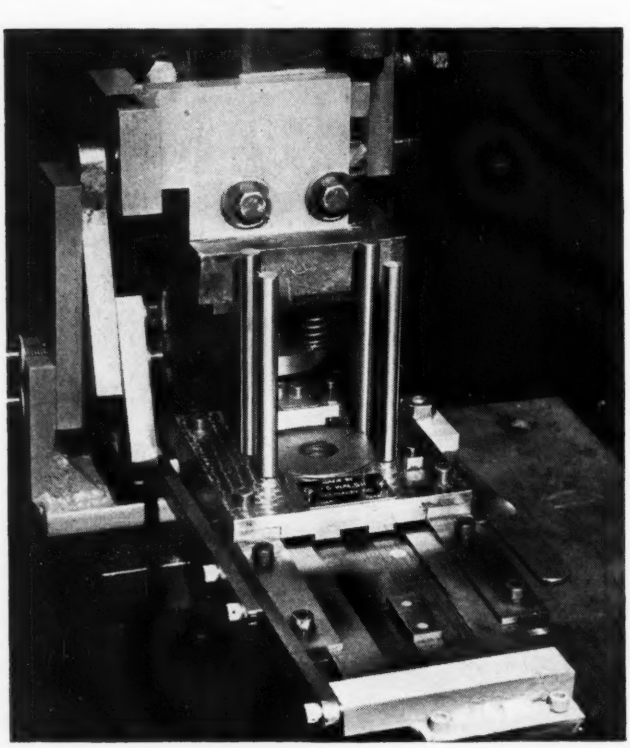
The new machine is powered with a 2-H.P. motor and a variable-speed drive that provides speeds ranging from 70 to 550 R.P.M. for handling various materials. 73

South Bend Precision Turret Lathe

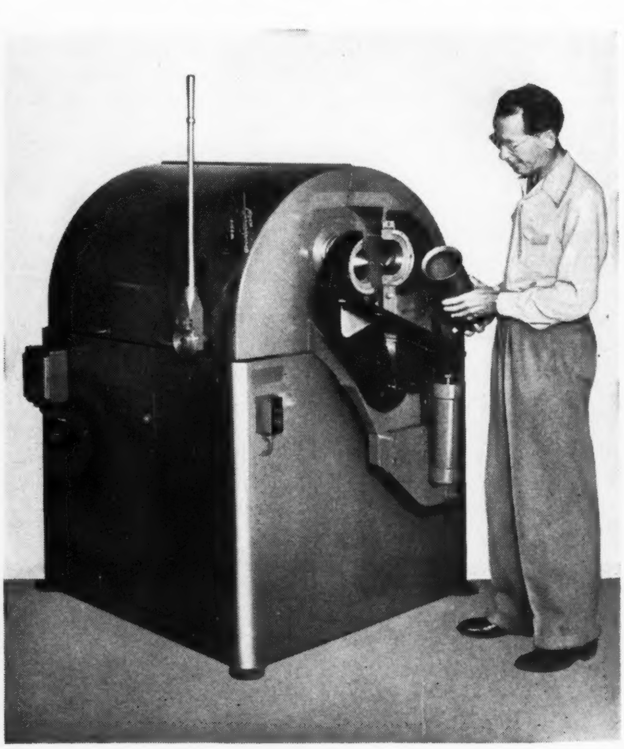
The South Bend Lathe Works, 383 E. Madison St., South Bend 22, Ind., have brought out an improved model of their No. 2-H precision turret lathe which was discontinued during the war to permit concentration on the manufacture of tool-room and engine lathes. Improvements incorporated in this new model include a turret-locking mechanism which will index the turret-head within plus or minus 0.0005 inch, measured at a distance of 4 inches from the turret face.

This lathe is designed specifically for the production of accurate, duplicate parts. It can be equipped with a universal chuck or an independent chuck for machining castings, forgings, etc., or it can be provided with a hand-lever draw-in collet attachment for use in machining bar stock or tubing.

The maximum swing over the bed is 16 1/4 inches, and over the cross-slide 6 7/8 inches. The maximum collet capacity is 1 inch (round stock), and the hole through the spindle is 1 3/8 inches in diameter. Holes for the tools in the hexagon turret are 1 1/2 inches in diameter. Clearance from center of tool hole to



Walsh blank-feeding and work-removing attachment for punch presses



"Tubemaster" machine set up for flaring large-diameter aircraft tubing

To obtain additional information on equipment described on this page, see lower part of page 242.

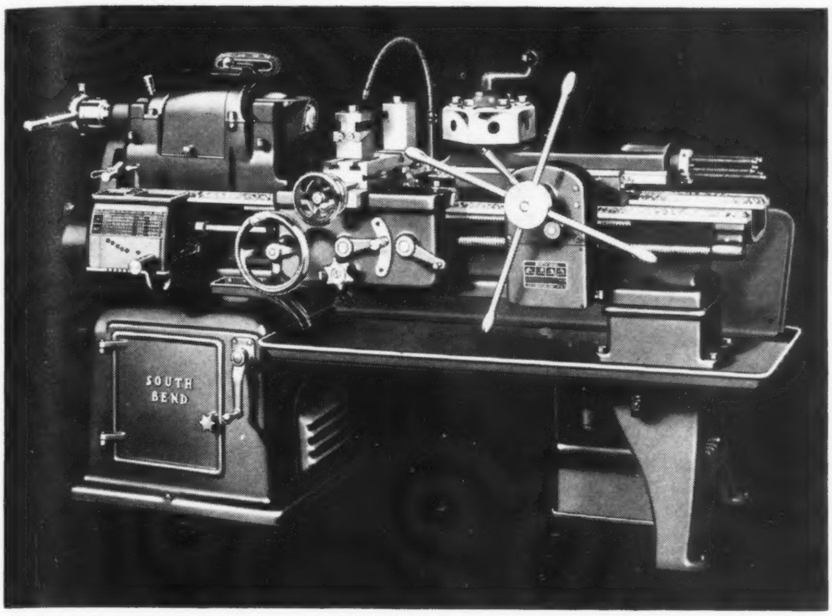


Fig. 1. Improved precision turret lathe brought out by the South Bend Lathe Works

top of turret-slide is 2 1/2 inches, and effective feed of turret-slide is 6 1/8 inches.

The universal carriage has a friction clutch drive, giving forty-eight cross-feeds ranging from 0.0006 to 0.0312 inch, and forty-eight longitudinal feeds from 0.0015 to 0.0841 inch, as well as a lead-screw and split nut that permits cutting forty-eight pitches of screw threads ranging from 4 to 224 per inch. Front and back tool-blocks on the screw-feed cross-slide take cutter bits 5/8 inch square. A four-way turret tool-block is available to order. A large-diameter micrometer-graduated collar on the cross-slide handwheel permits adjusting the tools with extreme accuracy.

The ram type hexagon turret has both power and hand feed, with an adjustable feed-trip and stop for each of the six turret faces. The turret-head indexes automatically on the return stroke of the turret-slide. The quick-change gear-box provides forty-eight changes for power turret feeds ranging from 0.0001 to 0.0148 inch. Change-gears in the turret apron provide an additional turret power feed which is independent of the universal carriage feeds in both rate and direction. The twelve spindle speeds range from 16 to 880 R.P.M. The use of a two-speed motor permits quick change from high to low speeds for reaming and tapping operations. 74

Denison Harmonic Stock Feed for Multipress

As many as 50,000 pieces per hour can be produced on an oil-hydraulic Multipress by automatic feeding of strip stock to the punching dies with the new harmonic stock feed developed by the Denison Engineering Co., 1152 Dublin Road, Columbus 16, Ohio. This attachment is available in several models, providing wide, stepless variations in speed and feed. Up to approximately 838 cycles per minute are possible with the high-speed unit, and as few as 66 cycles at low speeds.

An accuracy of plus or minus 0.002 inch is said to be maintained with this feeding equipment. It will handle coil stock up to 3 inches wide and 3/64 inch thick with a 3-inch feed per stroke. The feeding motion is positively synchronized with the motion of the press ram. Rota-

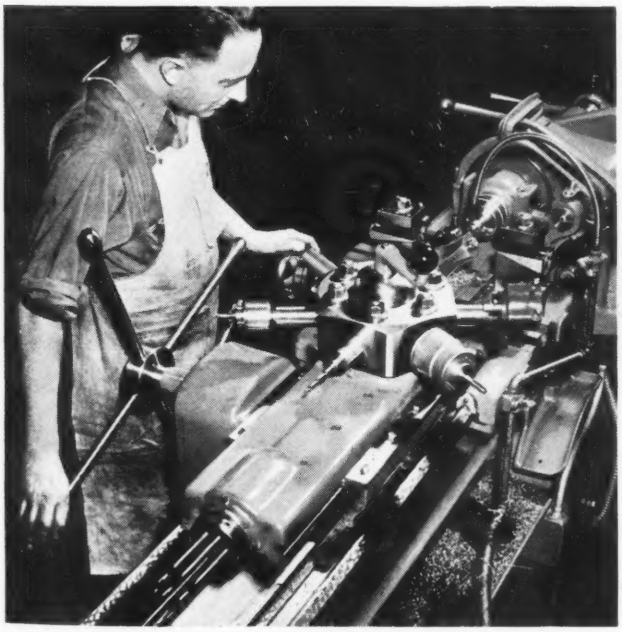
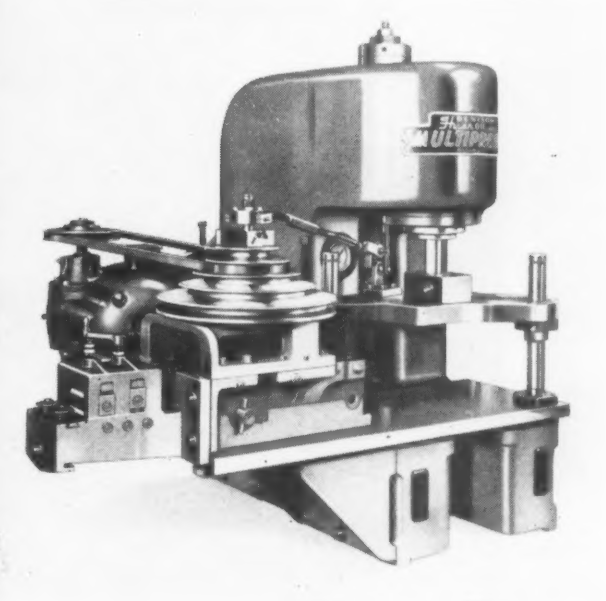


Fig. 2. South Bend turret lathe equipped for manufacturing small part



Denison harmonic stock feed applied to oil-hydraulic Multipress

To obtain additional information on equipment described on this page, see lower part of page 242.

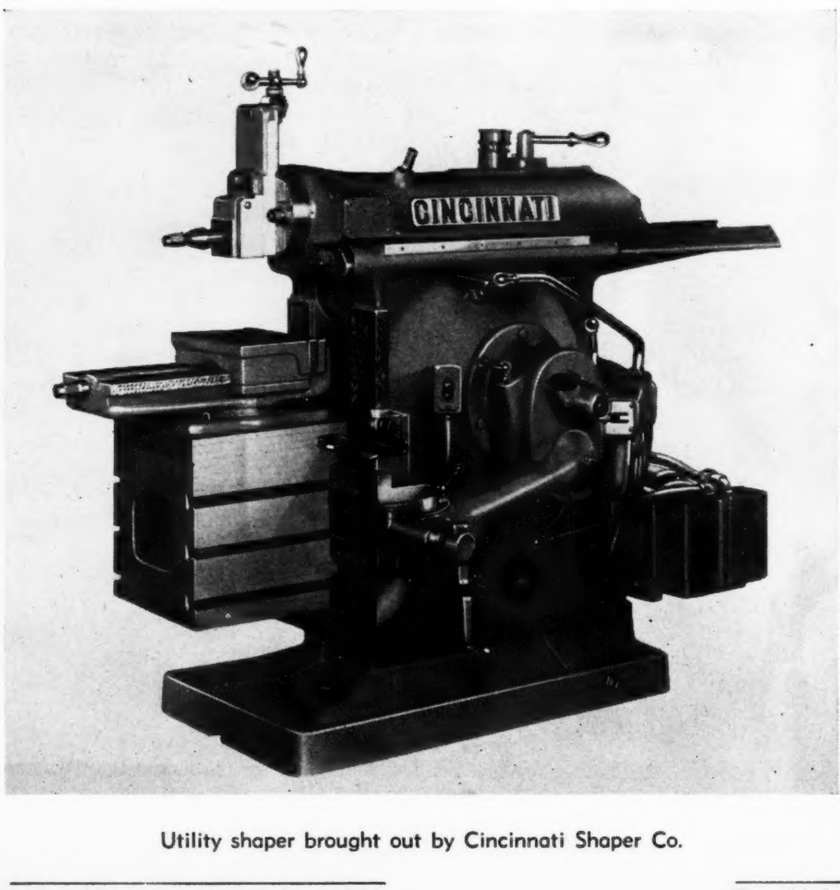
tion, or harmonic movement, of the valve control crank on the multi-speed pulley assembly of the feed causes the linkage fastened to the guided platen to be raised or lowered. The linkage, in turn, moves the ram control-valve spool up or down, directing oil from the press hydraulic system to either the top or bottom of the ram cylinder. This raises or lowers the ram to complete each punching or work cycle. The material is fed a predetermined distance with each cycle. Speed, stroke, pressure, and all other adjustments can be easily made by means of controls on both the attachment and the press.

The feed mechanism can be operated by hand to facilitate locating the dies and thus reduce set-up time. In the event of a pile-up of material at the die, it is said that no major damage would occur to either the press of the dies. The strip stock is held firmly by an adjustable holding mechanism that permits it to be fed forward only. An automatic stock release may be engaged for piloted punches. Straightening rolls are an optional feature of the feeding attachment. This feed is available at present for use with Multi-presses up to 8 tons capacity......75

Cincinnati Utility Shapers

A shaper designed especially for tool-rooms and maintenance shops requiring a fast, moderately priced utility tool is now being manufactured by the Cincinnati Shaper Co., Cincinnati 25, Ohio. This shaper embodies the many refinements found in the larger Cincinnati machines. The table is supported directly on the cross-rail without an apron, and is heavy enough to take the full load without extra support. This construction increases the rigidity of the table by reducing overhang.

The new utility model shapers are equipped with higher speeds to permit the efficient use of carbide tools. Cutting speeds of over 250 feet per minute are possible with a 10-inch stroke. Among the other new and improved features are automatic lubrication to all bearings, including the table bearing on the rail; single-point taper gib adjustment; improved rail lock that is controlled from the operator's position; a vastly improved tool lifter; power down feed to the head; and power rapid traverse to the rail. These shapers are made in 16- and 20-inch stroke sizes, and can be equipped with a 3- or 5-H.P. motor drive..........76



Utility shaper brought out by Cincinnati Shaper Co.

Micrometer lapping and testing kit brought out by Van Keuren Co.

Van Keuren Lapping and Testing Kit

The Van Keuren Co., 178 Waltham St., Watertown, Mass., has brought out a new micrometer lapping and testing kit designed to enable machinists and toolmakers to maintain the original accuracy of their micrometers and acquire skill in performing precision lapping operations. The regular No. 45 kit is designed for lapping and testing micrometers with a range of from 1 to 2 inches, and makes it possible to lap the micrometer anvil and spindle surfaces flat and square with the axis of the screw to 0.00001 inch.

The kit consists of two double surface laps, one of which is 1 by 1 1/4 inch in diameter, and the other 1.0125 by 1 1/4 inch in diameter, both being flat and parallel within 0.000005 inch; one 3/16- and 1/4-inch ball tester; and two drams of finish lapping compound. The object of using two thicknesses of laps is to obtain measuring surfaces that are square with the axis of the spindle. With a 1-inch lap only, the surface might be lapped parallel, but at a slight angle to the axis of the spindle. This condition is corrected by the use of the 1.0125-inch lap, which causes the spindle to be at the half-turn position. The ball tester shows the flatness and parallelism of the measuring surfaces, and will detect an error as small as 0.00001 inch.

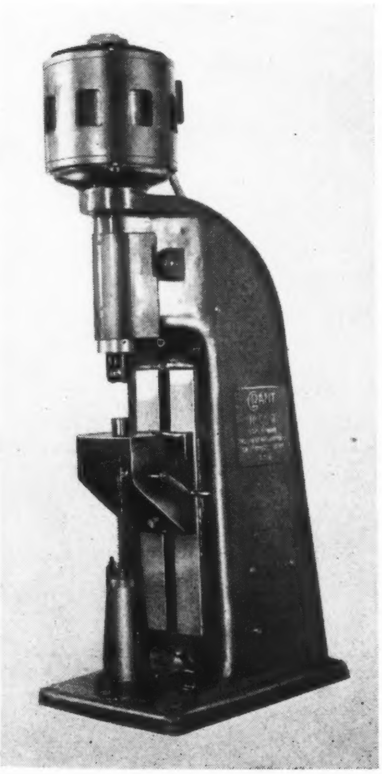
To obtain additional information on equipment described on this page, see lower part of page 242.

Kit No. 45 B consists of the same equipment, but has 1/4- and 3/16-inch laps, and is designed for micrometers with a range of from 0 to 1 inch. Kit No. 45 A comprises the same equipment but with an additional 1-inch lap, and may be used for micrometers with a range of from 2 to 3 inches.....77

Grant Noiseless Rivet-Spinning Machine

The Grant Mfg. & Machine Co., N.W. Station, Bridgeport 5, Conn., has recently added a No. 520 noiseless rivet-spinning machine with an automatic trip mechanism to its line of riveting equipment. The new machine is designed for heading unusually large rivets, having a capacity for rivets up to 3/4 inch in diameter, and, in special applications, up to 1 inch.

The distance from column to spindle is 8 inches, and the spindle travel is 1 inch. A 10-H.P., 750-R.P.M. motor drives the spindle, and a 2-H.P., 1750-R.P.M. motor operates the automatic trip, which makes it unnecessary for the operator to apply hand pressure for the spinning operation. Automatic operation is accomplished through a foot-operated button. The height is 79 inches, and the weight 2500 pounds.......78



Grant noiseless rivet-spinning machine

Automatic precision cam-profiling machine built by George Gorton Machine Co.

Gorton High-Accuracy Cam Profiler

The George Gorton Machine Co., Racine, Wis., has developed a new cam-profiling machine designated "Contour Mill No. CM-12," in which rotary work and master tables, variable ratios, and automatic cycling features have been incorporated. This machine will handle either internal or external profiling or grooving work, as well as cam milling operations. It is built to maintain extra close tolerances and to produce exceptionally high surface finishes on a wide variety of work.

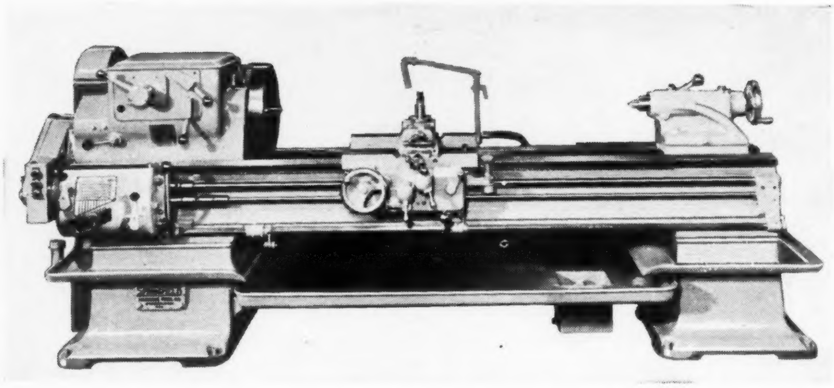
Basically, this is a tracer-controlled, swivel-head milling machine which employs rotary tables for both work and master. It operates at reduction ratios of from 2 to 1 up to 10 to 1. The machine will contour-mill the profiles of all conventional cam shapes that do not include negative angles. Most interrupted cam shapes that lend themselves to continuous-cycle profiling can also be handled.

The two 16-inch roller bearing rotary tables mounted on the bed of the machine are geared together and driven by an infinitely variable speed unit. The cutter- and tracer-spindles are supported on a rugged tracer extension arm. Settings for the desired reduction ratios are made by moving the micrometer bracket to the right or left on the extension arm in accordance with the calibrations on its face. A lead-screw is provided for locating the work-piece table under the cutter-spindle. After the work has been properly located, a push-button is pressed to turn on all motors and begin the machining cycle, which is then completed automatically and the machine brought to a stop without further attention. The shape of the work produced is determined by the shape of the master, the cutter being fed into the work at a fixed depth by the tracer feed-cam.

Spindle speeds from 300 to 10,000 R.P.M. permit the use of high-speed steel cutters, carbide cutters, or burrs. In some cases, grinding wheels can also be employed. Provision is made for easy adjustment to compensate for cutter or wheel wear.

Since all machine elements have individual motor drives, the basic machine can be readily modified to suit a wide range of applications. It is regularly furnished with a 1/2-H.P. spindle motor, but motors up to 2 H.P. can be furnished to meet requirements. The size and type of motor required for the rotary tables and tracer feed-cam will depend upon the work to be handled. The machine is approximately 91 inches long, 25 inches wide, and 75 inches high. It weighs about 4250 pounds. 79

To obtain additional information on equipment described on this page, see lower part of page 242.



New model lathe of improved line brought out by the Springfield Machine Tool Co.

New Springfield Lathes

New model engine and tool-room lathes have been announced by the Springfield Machine Tool Co., Springfield, Ohio, in which special consideration has been given to ease of operation, simplicity of design, and rugged proportions. Sixteen spindle speeds, increased horsepower capacities, and several optional speed ranges are available for work requiring slow speeds for heavy cuts, as well as high speeds for carbide tooling. The tool-room lathes range in size from 14 to 25 inches, and the engine lathes are built in sizes of 14 to 32 inches, in both standard and block gap types.

The three-lever gear-shifting system is designed without any pass-through gears, to facilitate operation. All shifting levers are arranged to require a minimum of amount of shifting for a normal sequence of lathe operations. The headstock lubrication oil sump has been located in the cabinet leg instead of in the headstock, so as to minimize heat rise of the headstock under heavy high-speed spindle operations.

An entirely new design of feed-box incorporates lifetime-lubricated sealed ball bearings. Sixty threads and feeds are available, with optional ranges that include 11 1/2- and 27-pitch thread leads, in addition to other standard pitches. Loose change-gears, are used only when transposing to metric thread leads or for obtaining ranges of extremely special nature.

Heavy beds with either precision hand-scraped ways or with replaceable hardened tool-steel face way inserts can be supplied. Double cam-actuated friction feed clutches assure positive engagement and disengagement of feeds. A new design of simple chasing dial is standard equipment, and large, easily read micrometer dials are furnished on both the cross-slide and the compound rest.

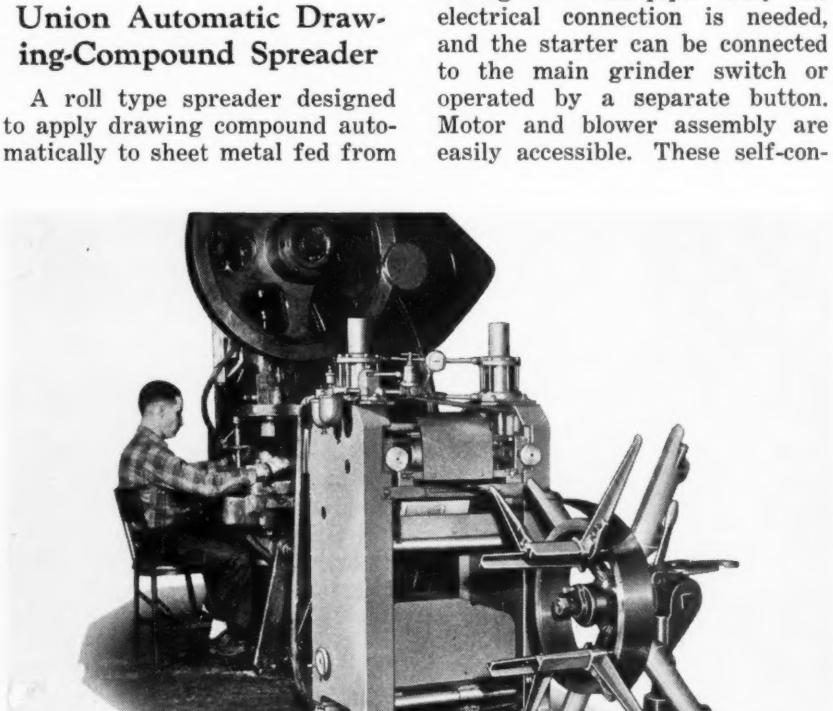
The heavy-duty type tailstock has a long table travel range. Lubrication includes the tailstock barrel and nut and also the tail-stock bed ways. A complete line of accessories and equipment for both tool-room or production work is available for these improved lathes. 80

Union Automatic Drawing-Compound Spreader

A roll type spreader designed to apply drawing compound automatically to sheet metal fed from coils or stacked sheets has been brought out by the Union Tool Corporation, 314-320 E. Market St., Warsaw, Ind. This spreader eliminates hand brushing or swabbing, and applies a coating of compound that is of uniform thickness. The rollers that apply the compound can be adjusted for speed, thickness of metal, and quantity of compound applied. The spreader is available in models that will handle sheet metal in widths of 1 to 96 inches. 81

Hammond Semi-Portable "Duskolectors"

Hammond Machinery Builders, Inc., 1614 Douglas Ave., Kalamazoo 54, Mich., have brought out three recently redesigned "Duskolectors," each size unit being designed to cover a wide range of applications, so that it can be used with different grinding machines. The proper size unit can be easily installed, independently of other dust arrester systems. Installation requires only piping to the grinder with flexible metal tubing or metal pipe. Only one electrical connection is needed, and the starter can be connected to the main grinder switch or operated by a separate button. Motor and blower assembly are easily accessible. These self-con-



Press equipped with spreader made by Union Tool Corporation for applying drawing compound to sheet metal fed from coil

To obtain additional information on equipment described on this page, see lower part of page 242.

Semi-portable "Duskolector" brought out by Hammond Machinery Builders, Inc.

tained units are designed to occupy a minimum of floor space relative to their operating capacities.

Dust-laden air is drawn from the grinder wheel hood through the air expansion chamber at the bottom of the cabinet, where the heavier particles drop into the dust-pan due to decreased air velocity at this point and to special airfin construction. The air is then drawn up through a set of three fiber glass filters which remove the finer particles. These filters are of an inexpensive type and can be cleaned several times by shaking before they need to be replaced. Since the air is drawn from the grinder and merely recirculated in the room, there is no loss of heat.

The three sizes have 1/4-, 1/2-, and 1-H.P. motors, and capacities of 330, 700, and 1000 cubic feet of air per minute, respectively. 82

Pereco Molybdenum-Vacuum Electric Furnace

High-temperature operation up to 3500 degrees F. under a neutral or reducing atmosphere of sufficient purity to permit sintering chromium without oxidation is possible with the new Model MO - 224 molybdenum - vacuum electric furnace placed on the market by Pereny Equipment Co., 893 Chambers Road, Columbus 12, Ohio. The recommended average operating temperature of this furnace is approximately 3300 degrees F., a maximum peak of 3500 degrees F., being available for short cycles.

The steel case of this unit is designed to maintain a vacuum of 30 inches of mercury. The furnace can be positioned either horizontally or vertically. This dual type furnace is so constructed that the inner or primary tube containing the molybdenum element can be removed readily without disturbing the furnace proper. The element is designed to compensate for heat gradient at the tube ends.

The working area of the furnace has an inside diameter of 2 inches, is 28 inches long, and has a controlled temperature length of 18 inches. It has one open end with a 10-inch sight tube, and can be supplied with both ends open if required. The sight tube and face of the furnace are water-cooled. A Pyrex or quartz sight lens is provided, which can be quickly removed or replaced. 83

Vanott Polishing Machines

New buffing and polishing machines designed to provide a greater range of movements for polishing large-area work have been announced by the Vanott Machine Corporation, 236 Colgate Ave., Buffalo 20, N. Y. Machines of the type shown in the illustration are available in one-, four-, and eight-spindle units with heads that can be swiveled automatically by depressing a foot-lever. The right-angle movements are accomplished by means of two handwheels.

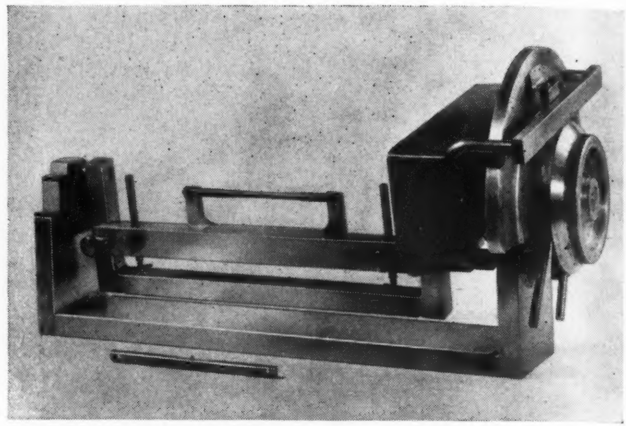
The range of vertical adjustment has been increased, and automatic oscillating movements up to 6 inches are available in the new machine. Chucks for holding the parts to be polished are built to meet individual needs. 84

Pereco molybdenum-vacuum electric furnace

Vanott single-spindle polishing and buffing machine

To obtain additional information on equipment described on this page, see lower part of page 242.

"Lincwelder 60" and accessories designed for welding, soldering, and brazing light-gage metals

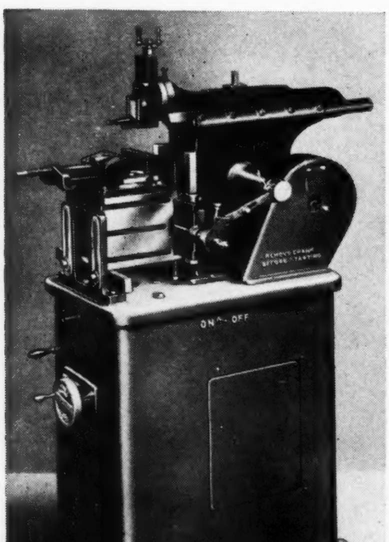


Grinding-wheel radius, tangent, and angle dresser placed on the market by the Conco Tool Co.

Lincoln Arc-Welder for Light-Gage Work

A small, low-cost arc-welder, designated the "Lincwelder 60," has been developed by the Lincoln Electric Co., Cleveland 1, Ohio, for operation on a 110-volt light circuit. In spite of its small size, this machine has operating characteristics comparable to larger industrial welders. It is adapted for use in automobile body repair, bicycle repair, radio, refrigerator, and other repair shops, as well as in production plants and home work-shops.

The new welder has a maximum output of 60 amperes, and can be used for a variety of light-gage metal-working jobs, as well as for joining heavier material, such as strap stock, pipe, tubing, angles, and other shapes. It can also be employed for cutting metals, soldering, making wire connections, brazing, and heating work preparatory to bending. A 30-ampere fuse is used when operating on a standard 110-volt light circuit. The complete welder weighs about 50 pounds.........85



Logan shaper built for rapid, efficient handling of small work

Logan Small-Size Shaper

A small-size shaper of improved design has been brought out by the Logan Engineering Co., 4901 W. Lawrence Ave., Chicago 30, Ill., to meet the needs of repair shops, school work-shops, and machine-building plants. It has a powerful 8 1/2-inch stroke which permits accurate machining of work 8 inches long. Straight, angular, squaring, and slotting cuts can be handled with a minimum of set-up time.

Six automatic feeds are available in either direction, ranging from 0.002 to 0.012 inch, the setting for the desired feed being made with a dial graduated to 0.001 inch. A half turn of the feed-handle in either direction reverses the feed. Any speed, from 35 to 180 strokes per minute, is quickly obtainable by turning a handwheel.

The table, 8 inches wide by 8 inches long, has a vertical travel of 5 1/2 inches and a traverse of 10 1/2 inches. The adjustable table support, mounted on the base of the machine, provides solid reinforcement and assures extra capacity on heavy cuts without chatter. The tool-head can be swiveled 360 degrees for squaring the ends of stock of almost any length. 86

Conco Tool-Dresser

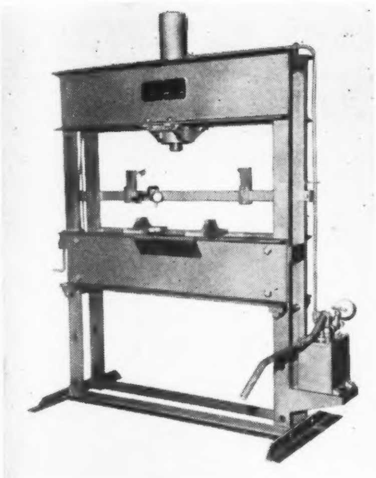
A new radius, tangent, and angle dresser for grinding wheels is being placed on the market by Conco Tool Co., 1041 McCartney St., Pittsburgh 20, Pa. Features of this dresser include a diamond set in the side of a bar which is supported at each end to provide clearance when dressing deep concave radii and to insure rigid support and accurate positioning of the diamond. The rotating element is also supported at both ends to give the diamond "between centers" support, which contributes to accurate, chatterless dressing.

The dressing diamond is rotated by using the bar that extends across the face of the dial as a crank. Sidewise movement of the diamond for dressing tangents and angles is effected by turning the large knurled knob shown just below the bar.........87

Control Valve for Oil-Hydraulic Systems

A new V8 series oil-hydraulic control valve for large-volume oil-hydraulic systems for presses and heavy-duty industrial equipment has been announced by the Hydraulic Equipment Co., 1100 E. 222nd St., Cleveland 17, Ohio. These valves will handle 80 gallons of oil per minute at operating pressures up to 1000 pounds per square inch. Models are available for operating up to as many as three single-acting or double-acting hydraulic cylinders. Features include the "Hydreco" hollow plunger construction with built-in check valves and adjustable differential type relief valves. 88

To obtain additional information on equipment described on this page, see lower part of page 242.



Light-duty shop press recently added to the line manufactured by Rodgers Hydraulic, Inc.

Rodgers Light-Duty Shop Presses

Rodgers Hydraulic, Inc., Minneapolis, Minn., has added 60- and 80-ton capacity presses to its line of shop presses, which now includes machines with capacities ranging from 60 to 400 tons. The new presses are designed to meet the need for light-duty machines that will provide fast, versatile action on a wide range of shop work.

The features include a full 13-inch pressure stroke; accurately matched and machined V-blocks; lower bolsters supported by bearing blocks; steel support pins; fast arbor press action, which eliminates need for separate arbor press; and provision for operation by either hand or power pumps, faster speeds being obtained by equipping the presses with power-driven pumps.

The improved two-speed hydraulic hand-pump with automatic shift permits a fast ram speed of 1 1/8 inches per stroke with a 2-ton high-speed pressure on the 60-ton press, and a 3/4-inch travel with a 3-ton pressure on the 80-ton press. When the maximum 2- or 3-ton pressure has been reached, the pump shifts automatically to high-pressure operation. 89

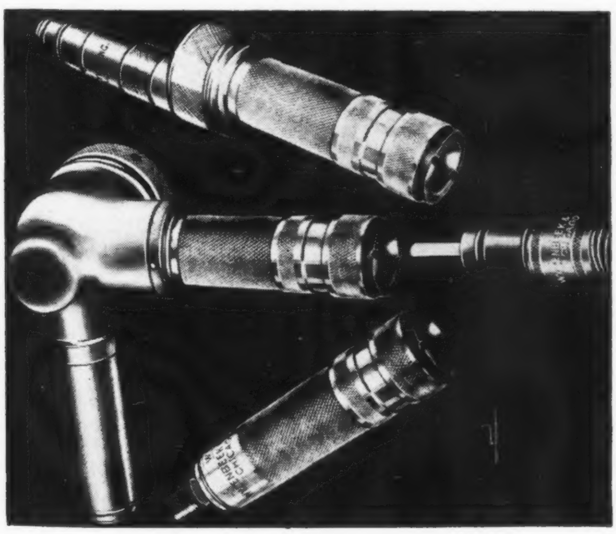
Quick-Change Hand-Pieces and Angle-Heads for Flexible-Shaft Machines

Hand-pieces with quick-change couplings have been brought out by Wyzenbeek & Staff, Inc., 848 W. Hubbard St., Chicago 22, Ill., to increase the usefulness and efficiency of Wyco flexible-shaft machines. With the quick-change feature of these snap on or off devices, changes can be made from a straight hand-piece to an angle-head, or from a grinder to a sander, and then to a buffer or wire-brush wheel without loss of time and with complete safety to the operator. The quick-change feature is now available as standard equipment on all Wyco flexible shafts and machines, and can be applied to models in use at a nominal cost. 90

American "Screwstick"

The American Screw Co., Providence 1, R. I., has announced a new product, known as "Screwstick," which consists of identical small screws machined as a one-piece rod or stick. The screws are joined together by small-diameter necks, as shown in the view to the left in the illustration. When used in pneumatic or electric power drivers in the manner shown in the view to the right, the "Screwstick" serves to simplify the rapid assembling of many small parts. Hand drivers of the ratchet or spiral types are also available for use with "Screwsticks."

The screws are twisted off automatically when the torque predetermined by the diameter or cross-sectional area of the joining neck is reached. Thus all screws are driven or set with the same torque, and the necessity for maintaining an accurate torque setting for the driver is eliminated. As a tightened screw is freed from the connecting neck, the next screw in line is automatically advanced. The head of the driven screw is burnished by the end of the rotating screw to which it was previously joined. "Screwsticks" are available in Nos. 0, 1, 2, 3, 4, and 5 sizes in mild steel, brass, and aluminum. 91



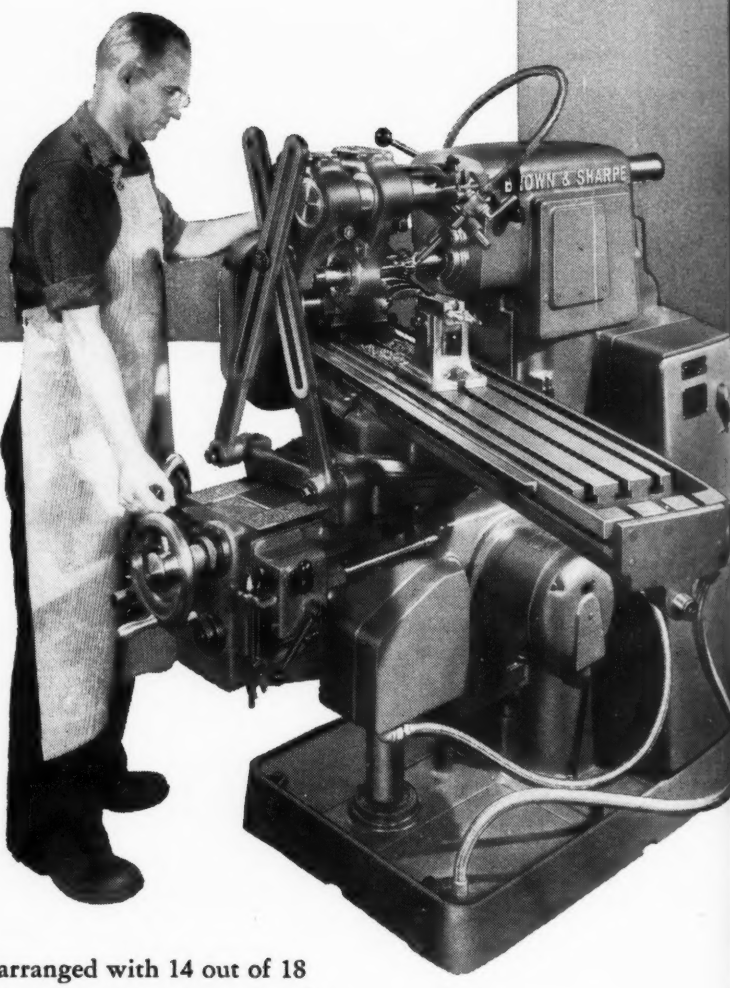
Quick-change hand-pieces and angle-heads for flexible-shaft machines, brought out by Wyzenbeek & Staff to facilitate performing such operations as grinding, sanding, polishing, deburring, and scratch-brushing in any desired order and rapid succession

(Left) "Screwstick" consisting of small screws machined from single rod, the head and end of adjacent screws being joined by a neck of small cross-sectional area. (Right) Power-driver-using "Screwstick" being applied for rapid fastening of small parts

To obtain additional information on equipment described on this page, see lower part of page 242.

Get these extra advantages of *Extended Spindle Face* design

EXCLUSIVE IN BROWN & SHARPE 3 AND 5 H.P. UNIVERSAL AND PLAIN MILLING MACHINES



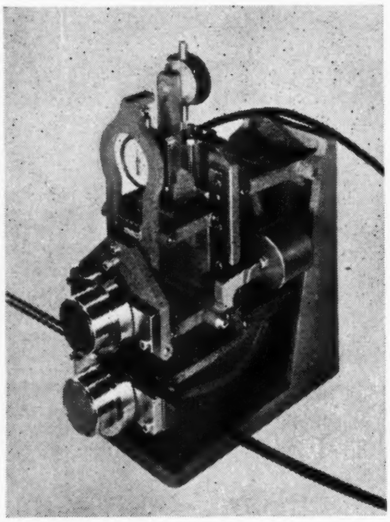
FIVE important milling advantages, results of the Extended Spindle Face design, are illustrated on the opposite page. Each represents a distinct saving in time, in manpower, in cutter costs, or in equipment. All offer exclusive, timely ways to boost the efficiency of your milling operations.

These advantages are "extras", over and above the other well-known advantages of the Brown & Sharpe 3 and 5 Horsepower Machines—maximum power for cutting (three advantageously-placed driving motors avoid loss of power within machine) . . . an excellent choice of feeds in a range where most of the work is done (table feeds arranged with 14 out of 18 under 10″ a minute) . . . feed rates uniform in all directions, assuring identical surface finish on those jobs requiring vertical and longitudinal feeds.

Get all the facts about these machines and see where they can help you to improve your milling operations. Write for bulletins on the 3 and 5 Horsepower Universal and Plain Milling Machines. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

CAPACITIES The 3 Horsepower No. 2 Universal and Plain Machines have a longitudinal feed of 28″, transverse feed of 10″ and vertical feed of 15″. The 5 Horsepower No. 2 Machines have the same capacities except for a 16½″ vertical feed.

BROWN &

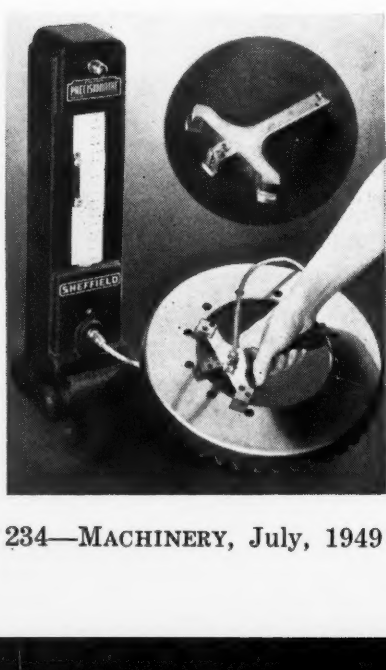


Gage for Measuring and Controlling Thickness of Coating Deposited on Wire

Continuous measuring gage which accurately and automatically measures and controls the thickness of the plastic coating deposited on copper electrical wire. The parallel precision rollers which contact the wire can be adjusted to exert just the right pressure to suit the hardness of the coating material. A continuous thickness and operating recorder can be installed if desired. Made by Federal Products Corporation, 1100 Eddy St., Providence 1, R. I. 92

Spider Type Spindle for Checking Shallow Holes with "Precisionaire" Gage

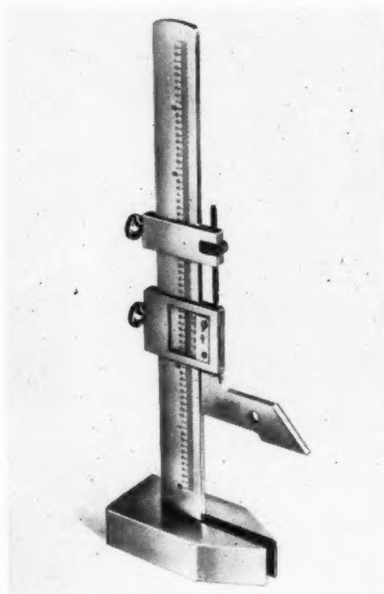
Checking a ring gear having a shallow, large-diameter hole with a "Precisionaire" flow type air gage using spider type spindle recently developed by the Sheffield Corporation, Dayton 1, Ohio. The reverse side of the new spindle is shown in the round insert. The spider



type spindle is designed to eliminate the difficulties of cocking and sticking often encountered in checking shallow, large-diameter holes which have a minimum bearing surface for the gaging spindle. The gaging equipment illustrated is used to check bell-mouth and out-of-roundness, as well as the internal diameter of the hole. 93

Vard Vernier Height Gage

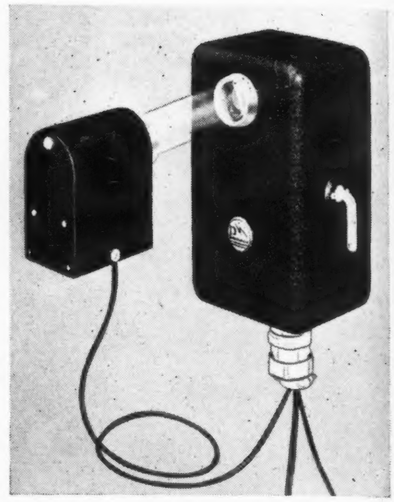
Vernier height gage with slotted base, which makes possible direct readings from 0 to 6 inches, eliminating the necessity for making computations. The adjustable vernier scale permits the zero setting to be maintained at all times. The gage is provided with a scriber point as an integral part of the jaw to facilitate rapid lay-out work. A hole is also



provided in the same jaw to permit quick attachment of indicators for all types of inspection work. The gaging surfaces are of hardened tool steel, and the leaf springs are made of beryllium copper to prevent wear on the beam. Announced by Vard, Inc., 2981 E. Colorado St., Pasadena 8, Calif. 94

Photoswitch Delayed-Action Photo-Electric Control

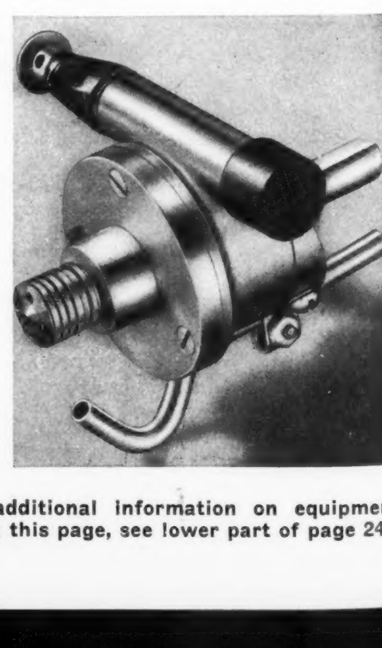
Delayed-action photo-electric control, brought out by Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass., to detect the jamming of cases, cartons, or parts on conveyor lines and actuate the conveyor stop or other corrective device. The control and light source are placed on opposite sides of the conveyor, so that when a case passes along the conveyor, it will interrupt the light beam. Relay action in the photo-electric control occurs only when the light



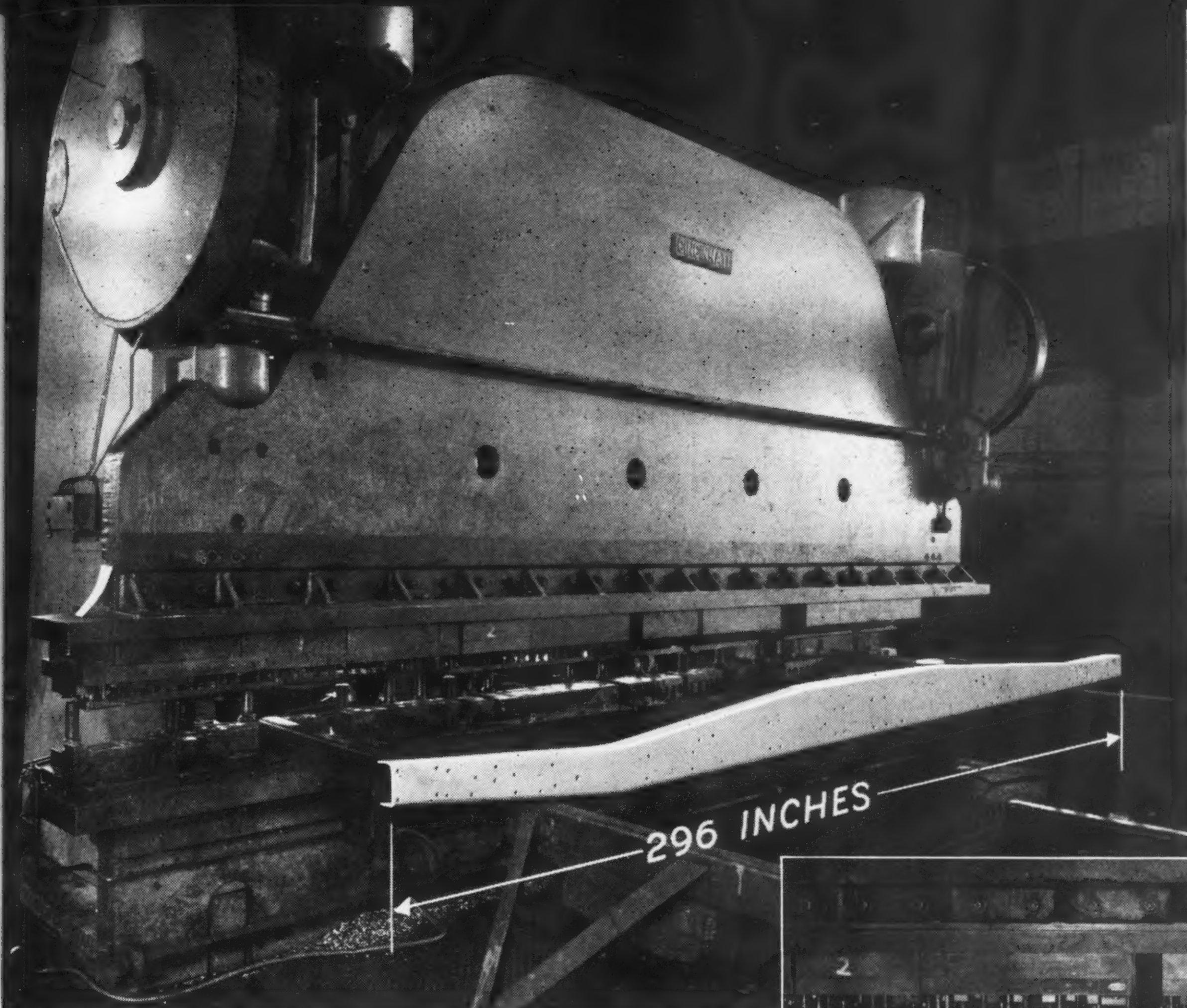
beam has been interrupted for a predetermined time interval, representing a longer period than would normally be required for a case or piece of work to pass the light beam. This excessive interruption of the light beam can be caused only by the jamming of several adjacent cases. Thus the control can be employed to prevent additional cases from entering the main conveyor line by stop-motion control of the feeder conveyors. 95

Dressing Diamond Holder with Automatic Rotating Feature

Automatic "DressOmeter" diamond actuator in which the compression of a plunger against the end guard of the grinding machine rotates the diamond automatically 22 1/2 degrees at each complete pass across the grinding wheel face. This assures effective cutting surfaces on sixteen facets, which is said to be the most economical diamond contact area. The "DressOmeter" has been thoroughly tested on all types of grinding machines and is of rigid construction throughout. It is enclosed in a dust-proof housing. Developed by J. K. Smit & Sons, Inc., Murray Hill, N. J. ..96



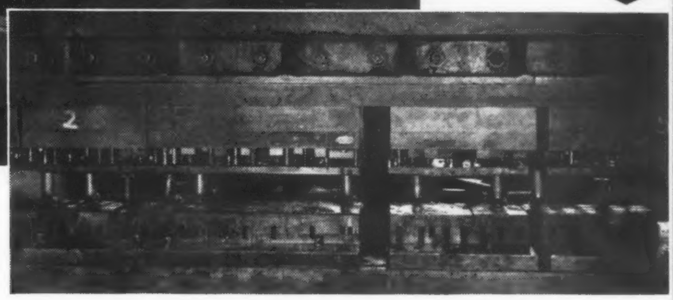
To obtain additional information on equipment described on this page, see lower part of page 242.



PHOTO—COURTESY YOUNGSTOWN STEEL CAR CORP.

Material: $\frac{3}{16}$" mild steel. Maximum number of holes: 104. Maximum diameter of hole: $1\frac{3}{16}$".

A close-up of the punch and die setup which gives 116 combinations.



PUNCHING

104 HOLES EVERY 10 SECONDS

The multiple punching of these holes must be very rapid; however, another important requirement is the maintenance of accurate location, and the spacing of one hole from another.

The assembly which follows is smooth and certain—no costly misfits on these 24-foot trailer frames.

On this Cincinnati Press Brake the spacing, the number of holes or the size of the holes may be changed quickly and economically, as required . . . or the brake may be used for many other operations—all accomplished with minimum time loss and at low cost.

Write for Catalog B-2. It illustrates many applications for the press brake and press work performed on Cincinnati Press Brakes.

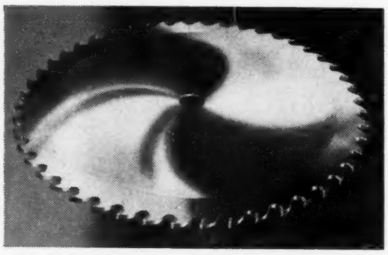
THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

Motch & Merryweather Carbide-Tipped and Cast-Alloy-Tipped Saw Blades

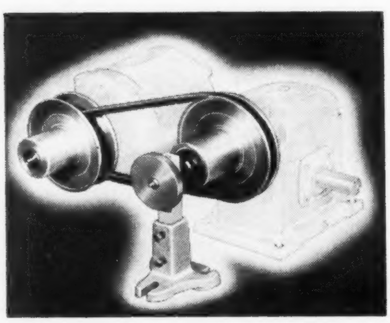
The Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, Ohio, has recently added carbide-tipped and cast-alloy-tipped saw blades of the



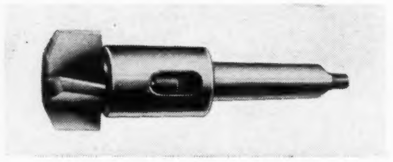
design illustrated to its regular line of "Triple-Chip" saw blades. The new blades, available in segmental or solid types, have either a "Triple-Chip" or special tooth grind. Segmental tipped blades are made in diameters up to 18 inches. Tipped blades are manufactured to customer's specifications or to meet specific production requirements. These blades are recommended for sawing plastics and non-ferrous materials and for milling ferrous and non-ferrous materials. 97

Variable-Speed Control Unit

New 1- or 2-H.P., low-cost, 6 to 1 variable-speed control unit using standard "B" section V-belts at any fixed center distance, announced by Speed Selector, Inc., 118 Noble Court, Cleveland 13, Ohio. The complete assembled unit includes two variable-pitch sheaves and control. The spring-loaded sheave

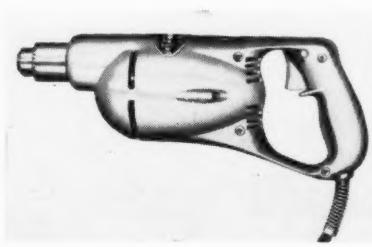


is mounted on the motor shaft, while the control sheave is mounted on the driven shaft. A regulating mechanism consisting of a handwheel and bracket, which is adjustable for any application, opens and closes the control sheave. The changes in pitch diameter cause the standard V-belt to actuate the spring-loaded motor sheave, thus giving stepless speed control over a 6 to 1 ratio range. Remote control can be easily applied to the unit. 98



Scully-Jones Core Drill

New high-speed steel core drill recently added to the line of precision production tools made by Scully-Jones & Co., 1906 S. Rockwell St., Chicago 8, Ill. Available in twenty-five different sizes from 1 1/2 to 3 inches in diameter. Designed to remove metal up to the equivalent of approximately 45 per cent of its diameter. Only four holders are needed for the entire series of twenty-five sizes of drills. The short length of the drill and counterbore driver eliminates excessive overhang, giving increased rigidity for precision work. Extension sockets are available for deep-hole drilling with these tools. 99

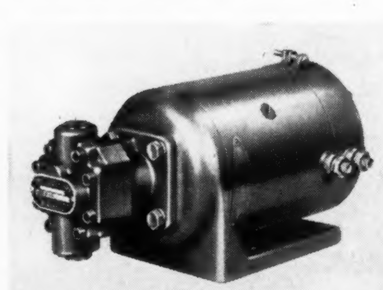


Cummins Standard-Duty Portable Electric Drill

Standard-duty 1/4-inch portable electric drill added to line of Cummins Portable Tools, Division Cummins Business Machines Corporation, 4740 N. Ravenswood Ave., Chicago 40, Ill. Designed for drilling metals, wood, and composition materials. The frame is die-cast aluminum. Tool is equipped with Jacobs 7B geared chuck. Universal motor operates on 115-volt, 25- to 60-cycle current. The length is 11 1/2 inches, and weight 4 1/2 pounds. 100

Barnes Gear Pump and Motor Unit

"Constant-Flo" rotary gear pump and motor unit with pump and motor exactly matched to assure maximum efficiency



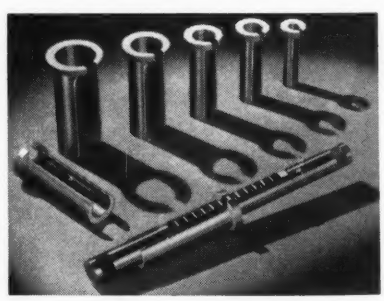
of both. This unit, brought out by the John S. Barnes Corporation, 147 Walnut St., Rockford, Ill., combines the specific model of this company's "Constant-Flo" rotary gear pump best suited to the customer's requirements with a special 12-volt series-wound motor of exceptionally sturdy design. 101

Micrometer Adjusting Nut

"Ful-Grip Micro-Nut" brought out by the Gairing Tool Co., 21225 Hoover Road, Detroit 32, Mich. Especially recommended for individual tool adjustment on multiple-spindle set-ups. It can be used on threaded adapters and holder assemblies with or without keyways. Accurate adjustment is facilitated by 0.001-inch graduations. The set-screw does not bear against the adapter threads. A full grip on the threads is obtained by moving top and bottom parts of nut in opposite directions, thus providing firm and parallel contact against end of machine spindle. 102

Eccentric Bushing Type Adapters for Glenny Broaches

Eccentric bushing type adapters developed by the Kase Machine Co., 18429 Buffalo Ave., Cleveland 19, Ohio, for use with the standard 3/8-,



5/8-, 3/4-, 1-, and 1 1/4-inch Glenny broaches of this company's manufacture. These adapters permit one size of broach to be used for cutting keyways in bores of six different diameters. In order to cut a keyway in a bore that is larger than the regular broach diameter size, the adapter is inserted in the bore and the broach is passed through it. The shoulders on the adapter prevent the broach from falling through during the cutting operation, and blade bend-

To obtain additional information on equipment described on this page, see lower part of page 242.

33% SAVED on Cast Steel

Satisfactory experience with other Cincinnati Bickford Super Service metal drilling machinery induced The R-S Products Company of Philadelphia, Pa., to install this 4' arm 13" diameter Column Super Service Radial.

They say, "Ease of handling has reduced operator fatigue and consequently has increased his productive capacity."

On these cast steel Butterfly Control Valve Bodies the floor to floor time on the previous machine was three hours, this same job, is now being done in two hours—a 33-1/3% savings.

4' arm 13" diameter Column Cincinnati Bickford Super Service Radial, drilling forty 1-1/4" diameter flange holes through 1-3/4" - 20" diameter Cast Steel Valve Body.

Good judgment in selecting the proper machines, tools, and fixtures will consistently produce the best manufacturing results. Our CUSTOMER PRODUCTION ENGINEERING SERVICE in the metal drilling field represents the collective experience of many years (since 1874). Make your problems ours - - let us show you a profitable Radial or Upright Drill production application. Your most urgent production problems warrant our immediate attention.

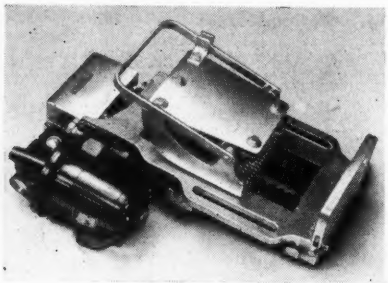
Equal Efficiency of Every Unit Makes the Balanced Machine

THE CINCINNATI BICKFORD TOOL CO.
RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

Radials 7½" dia. col., 2½' arm, to 26" dia. col., 12' arm.
General purpose Uprights, 21" to 28" sizes.
Production Uprights, 21" to 28".
Jig Borers, Portable Horizontals, Spacing Table Machines.

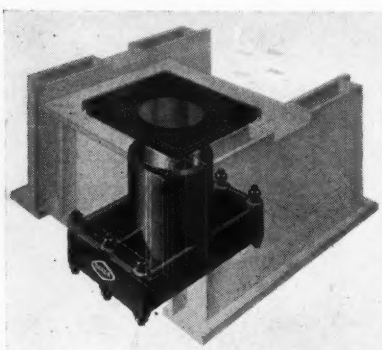
THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio

ing or breakage is eliminated by passing the entire broach through the work. The new adapters produce work that is accurate within 0.005 inch, and are available from stock, individually or in sets, in sizes ranging from 1/2 inch to 2 inches outside diameter. 103



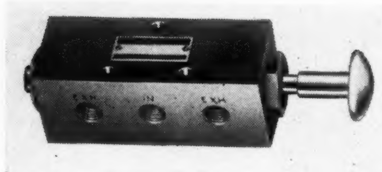
Improved Buffing Compound Applicator

Improved buffing compound applicator brought out by the George L. Nankervis Co., 5442 Second Boulevard, Detroit 2, Mich. All moving parts are enclosed to prevent clogging the mechanism with buffing compound, lint, etc. The applicator weighs only 22 pounds, and can be installed at any angle on automatic polishing machines. It has an intermittent feed operating at the rate of fourteen strokes per minute, which can be adjusted to apply just the proper amount of buffing compound. A totally enclosed, geared-head motor drives the unit. 104



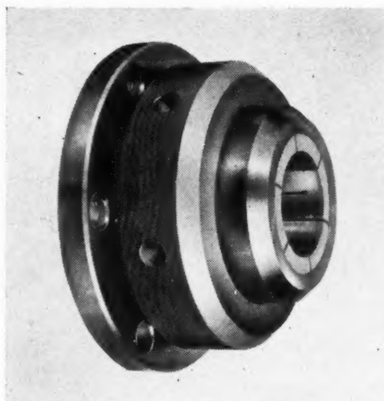
Baker Pneumatic and Hydro-Pneumatic Die Cushions

Phantom view of pneumatic or hydro-pneumatic die cushion brought out for use on all types of power presses by Baker Brothers, Inc., 1000 Post St., Toledo, Ohio. This pneumatic cushion is made in standard sizes from 4 to 28 inches in diameter in the single-piston type, and from 10 to 30 inches in diameter in the double-piston type. The size and number of cushions in a given installation depend on the press bed construction and pressure requirements. The cushions are self-contained, and can be supplied to fit any press regardless of size or make. 105



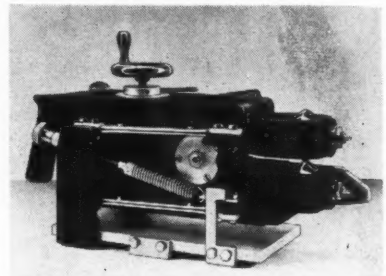
"Quick-As-Wink" Valve

Plunger type "Quick-As-Wink" control valve for air, oil, or water at pressures up to 125 pounds per square inch maximum, under normal temperatures (not exceeding 150 degrees F.). Furnished tapped for either 1/8- or 1/4-inch pipe connections. Available in two-way; three-way open exhaust; three-way piped exhaust; double two-way; four-way; and five-way designs; and with either push-pull or push and spring return actions. Valve consists of aluminum housing, hollow stainless-steel plunger with precision placed ports, brass gland nuts, ring packing, and aluminum push-button. Introduced by C. B. Hunt & Son, Inc., Salem, Ohio. 106



Non-Magnetic Chuck

Precision, non-magnetic, faceplate collet chuck made by Erickson Tools Division, 2311-A Hamilton Ave., Cleveland 14, Ohio, for use in the inspection of electrical parts. Every part of the collet chuck except the knurled spanner lock-nut is of a non-magnetic conductor material, yet electrical current is allowed to flow freely through the collet chuck for exacting inspection of work. Concentricity of the work is also maintained within close limits. 107

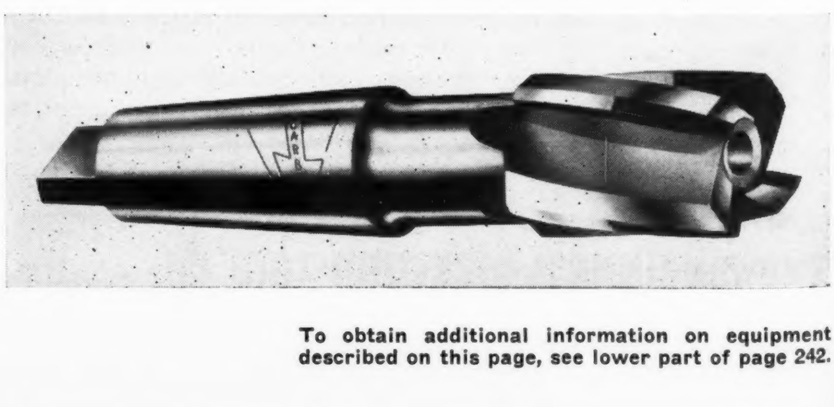


P & W Continuous Limit Gage

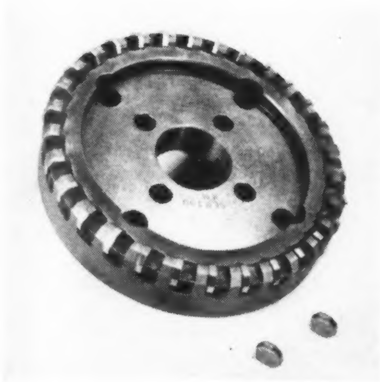
Continuous limit gage designed to protect metal stamping dies from being injured by material that is too thick. This gage indicates by a signal-light control relay, or similar device, when the strip or sheet material is too heavy. It does not show the thickness of the material or the amount of variation, but simply indicates whether the material is either heavy or light. When used with a die stamping press, it can be set to send out a signal that will stop the operation before the heavy material reaches the die. It also provides a means of inspecting continuous strip material when it is desired to control only one limit; that is, either the high or low limit. The range is from 0 to 0.300 inch, with an accuracy of 0.0005 inch. Can be easily set up by means of precision gage-blocks and by turning the handwheel until the setting light is on or just ready to go on. Made by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn. ..108

Wendt-Sonis End-Mill

End-mill developed by the Wendt-Sonis Co., Hannibal, Mo., which is available in styles for machining all types of steel, non-ferrous materials, and cast iron. The new carbide end-mill has extra strength in the body and additional backing for supporting the cutting edges, which are diamond-lapped. The shank is specially heat-treated to provide increased strength and rigidity. Available in straight and taper shank styles, with straight and right- or left-hand spiral flutes. Made in sizes ranging from 1/4 inch to 2 inches. 109



To obtain additional information on equipment described on this page, see lower part of page 242.

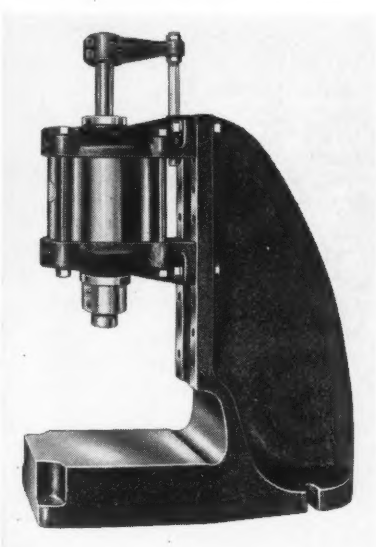


Diamond-Detroit Face-Milling Cutter

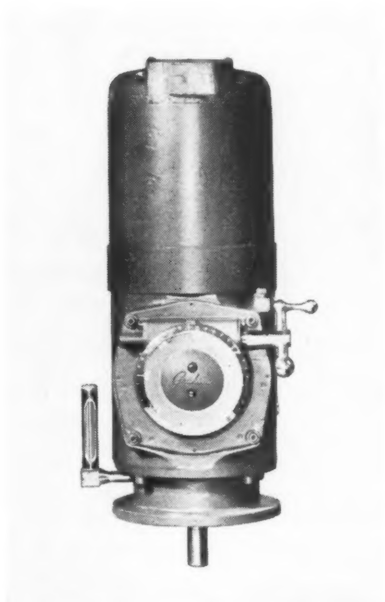
New high-production cast-iron face-milling cutter added to the line of "Future Mill" cutters manufactured by Diamond-Detroit, Inc., General Motors Bldg., Detroit, Mich. This cutter, designed for feed rates up to 60 inches per minute, has solid carbide octagonal-shaped blades which permit sixteen new cutting points to be used without resharpening any of the blades. When a blade becomes dull after cutting on one of the 45-degree chamfers, it is merely indexed to the next position; then, after eight runs, the blade is reversed and an equal number of runs is obtained from the other side. The necessary rake, relief, and clearance angles are all provided for in the design of the ground cutter body. The blades are accurately set to a uniform height by means of a locating pin. 110

Bellows Improved Arbor Press

Improved air-powered arbor press brought out by the Bellows Co., 222 W. Market St., Akron, Ohio. A specially designed double-acting air cylinder provides full control of both the advancing and retracting strokes of the ram, which



permits assembly operations on the most fragile parts. The power thrust developed is about twenty times the air-line pressure, and the press will operate on any pressure up to 175 pounds. Provision is made for positive adjustment of stroke length from a fraction of an inch to 2 1/2 inches. The ram is held in a non-rotating position, enabling the arbor press to be used for light die cutting or stamping operations when register is involved. The ram clearance is variable in steps of 1 1/2 inches, up to a maximum of 7 inches. The throat clearance is 5 inches, and the table is 8 by 9 inches in size. 111

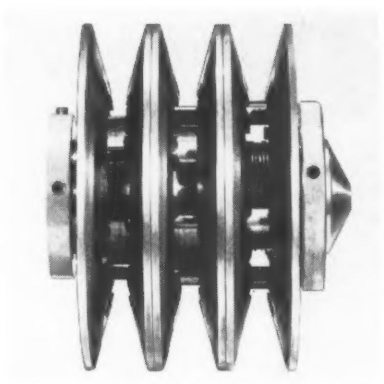


Variable-Speed Transmissions Designed for Vertical Flange Mounting

All speeds from 1100 R.P.M. down to zero are available with this new Type F variable-speed transmission brought out by Graham Transmissions, Inc., 3754 N. Holton St., Milwaukee 12, Wis. It is made in sizes from 1/4 to 1 H.P., and is designed for vertical flange mounting. Special shaft extension can be furnished when required. Constructed with spaced bearings on the output shaft and two tandem mounted oil seals to insure against oil leakage. Micrometer control makes possible extremely accurate speed settings. Available without motor or with built-in 1800- or 3600-R.P.M. motors. 112

V-Belt "Maxi-Pich" Sheave

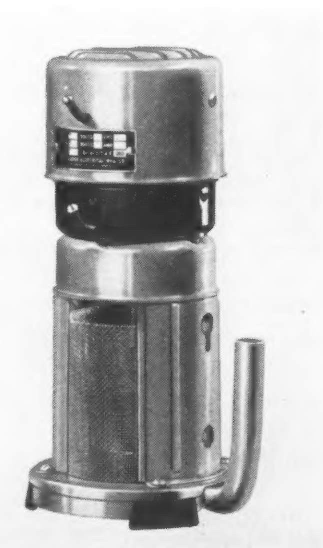
V-belt "Maxi-Pich" sheave brought out by the V-Belt Engineering Co., Aspen Ave., Richmond, Va. This sheave is especially designed to save installation and operating costs, as well as to provide efficient speed control. A maximum pitch-diameter variation approximating 250 per cent of the width of the



belt section is made possible by interlocking splined surfaces at the bottom of the groove. A simple turn of the handwheel on the sheave controls the pitch variation for the belt sections used. The new sheave provides constant belt alignment with a standard motor base. It is equipped with interchangeable steel hubs. A standard commercial V-belt companion sheave can be used with the "Maxi-Pich" sheave. These sheaves are available in six different pitch ranges, two each in belt sections A, B, and C. 113

Thermador Recirculating Pump

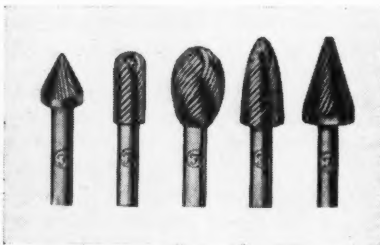
Recirculating pump capable of pumping 7 2/3 gallons per minute against a 2-foot head or 2 2/3 gallons per minute against a 10-foot head. This pump is driven by a specially designed Thermador 1/35-H.P. enclosed motor of the shaded two-pole type, operating on 60-cycle, 115-volt alternating current at 3100 R.P.M. Recommended for use with evaporative coolers, coolant systems for machine tools, welders' tanks, laboratory apparatus, and similar applications. Manufactured by Thermador Electrical Mfg. Co., Inc., 5119 District Blvd., Los Angeles 22, Calif. 114



To obtain additional information on equipment described on this page, see lower part of page 242.

Goggle for Use in Metal-Chipping Operations

New goggle compression-molded of extremely strong and durable phenolic compound, featuring dome metal side screens. The domed screens provide a greater cup area, giving cooler ventilation and increased side vision. The phenolic frame is non-flammable, moisture- and heat-resistant, and assures a better facial fit and maximum protection, plus wearing ease. The individually molded, non-reflecting eye-cups have large, rounded, face-contacting edges. Announced by the American Optical Co., Southbridge, Mass. 115

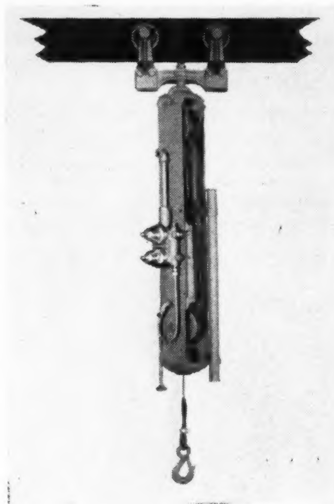


Carbide Cutters

Carbide cutters of new shapes recently added to line of M. A. Ford Mfg. Co., Inc., 780 W. First St., Davenport, Iowa, to meet the requirements of a wide range of manufacturing operations, including filing, burring, grinding, countersinking, chamfering, light milling, and profiling. Especially adapted for tool, die, and mold machining work. 116

Platz Tool-Balancer

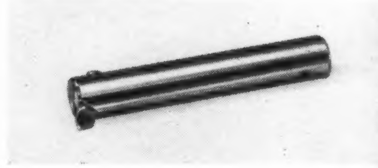
Tool-balancer designed to hold tools in a convenient position ready for instant application and easy operation. The balancer hangs from a fixed point or can be operated on a standard 4- or



6-inch I-beam. It can be swiveled vertically from 0 to 17 degrees and rotated through an angle of 360 degrees. Designed for balancing tools weighing from 10 to 500 pounds. Operates on an air-line pressure of 100 pounds per square inch. Made by Platz Co., 20433 Sherwood Ave., Detroit 12, Mich. ..117

"Taper-Bit" Boring Tools

"Taper-Bit" boring tools consisting of only two parts, a bar and a bit, which can be rigidly and quickly assembled for use by means of a simple taper fit. They are adapted for use on slotters, shapers, engine lathes, turret lathes, jig borers, screw machines, and production boring mills. The taper bits always extend ahead of the end of the bar so that



boring can be easily done up to a shoulder or face. The bars can be used either right or left hand. Made by Rockford Precision Tool Co., 924 King St., Rockford, Ill., in a variety of lengths and from 1/4 to 1 inch diameter. High-speed steel and tungsten-carbon bits are made in sizes of 1/8 to 5/16 inch...118

Kennametal Mechanically Held Offset Tool

Offset tool with mechanically held Kennametal tip, for machining operations such as facing with tool shank perpendicular to the work or turning with the tool shank parallel to the work axis. The Kennametal tip is held in position in a heat-treated steel shank by means of a spring steel clamp. When the tip becomes dull it can be advanced and reground. Grinding is usually required on one surface only. Available in five sizes ranging from 1 inch square by 7 inches long to 1 inch wide by 1 1/2 inches high by 10 inches long. Manufactured by Kennametal, Inc., Latrobe, Pa. ..119

STYLE FRH
opposite hand
Style FLH

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described in this section is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in July, 1949, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

NAME.. **POSITION OR TITLE**..................................

[This service is for those in charge of shop and engineering work in manufacturing plants.]

FIRM..

BUSINESS ADDRESS..

CITY.. **STATE**...

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 248 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the July, 1949, Number of MACHINERY

Aluminum Structural Handbook

REYNOLDS METALS Co., 2500 S. Third St., Louisville 1, Ky. Handbook containing 124 pages of design data on load-carrying aluminum structures, including the figuring of tensile, compressive, bending, and shear stresses, as well as stresses in cylinders subjected to fluid pressures, together with information on fabricating and joining methods. Copies are available to designers, engineers, and architects if requested on a company letter-head addressed to Reynolds Metals Co.

Coated Abrasives

CARBORUNDUM Co., Niagara Falls, N. Y. Publication describing the outstanding features of the company's new service, research, and production facilities for the development and manufacture of coated abrasive products at Wheatfield, N. Y. Engineers, superintendents, production supervisors, and purchasing agents, can obtain copies by sending a request on a company letterhead to the Carborundum Co., Box 337, Niagara Falls, N. Y.

Gear Design

AMGEARS, INC., 6633 W. 65th St., Chicago 38, Ill. Eight case histories, taken from actual jobs, describing how gear costs were reduced or products using gear assemblies were improved. Copies will be sent to designing engineers and purchasing executives if requested on a company letterhead, directed to Amgears, Inc.

Extruded Rods and Shapes

TITAN METAL MFG. Co., Bellefonte, Pa. Folder giving the chemical composition of ten brass and bronze alloys used in Titan forging rods and shapes, as well as the average physical properties of forgings made from them. 1

Cemented Carbides

KENNAMETAL INC., Latrobe, Pa. Catalogue 49, containing 76 pages of data on the complete Kennametal line of cemented-carbide tools. Included is information on mechanical and physical properties, design data, recommended grades, cutting speeds, machining hints, tool wear analysis, and specifications and prices. 2

Multiple Drilling Machines

NATIONAL AUTOMATIC TOOL Co., Richmond, Ind. Circular entitled "Production Avenue U.S.A.," the second in a series of case histories of drilling problems, describing how a production bottleneck was broken and a great increase in output obtained by the use of Natco multiple drilling and tapping machines. 3

Air and Hydraulic Devices

LOGANSPORT MACHINE Co., INC., 810 Center Ave., Logansport, Ind. Circular entitled "The Facts of Life on Air and Hydraulic Devices," containing information for engineers and maintenance men, intended to help them obtain maximum performance from Logan air and hydraulic equipment. 4

Hydraulic Presses

A. B. FARQUHAR Co., 1504 Duke St., York, Pa. Catalogue HP-49, contains illustrations and complete specifications covering the company's line of hydraulic presses, built in a wide range of types for both light and heavy duty in the metal-working, ceramic, plastic, and rubber industries. 5

Micro-Centric Grinding Machines

CINCINNATI GRINDERS, INC., Cincinnati 9, Ohio. Catalogue G-573, illustrating and describing the design and construction of the new Cincinnati Micro-Centric grinding machine, designed to grind precision anti-friction bearings and other parts of cylindrical and similar shapes. 6

Remote Control Timing Device

PRATT & WHITNEY DIVISION NILES-BEMENT-POND Co., West Hartford 1, Conn. Bulletin describing the operation and applications of the Pratt & Whitney Syncro Timer, a remote control timing device for classifying and sorting continuously produced material. 7

Couplings and Fittings for Aircraft

AEROQUIP CORPORATION, Jackson, Mich. Aircraft catalogue containing 52 pages of engineering and installation data on this company's line of flexible hose lines, hose fittings, self-sealing couplings, and the Aeroquip "Hydrofuse" for use on aircraft. 8

Lubrication

FISKE BROTHERS REFINING Co., 133 Lockwood St., Newark 5, N. J. Publication entitled "The Lubriplate Film," containing a description of the Lubriplate tag plan for assuring proper lubrication of machines after they leave the manufacturer's plant. 9

How the base metal protects the finish

This is a typical example of a fine emblem, combining good design, excellent materials, and a high degree of art and craftsmanship in production.

It is almost always the case, though unsuspected by the general public, that the material to which a finish is applied has a definite influence upon the perfection and durability of that finish. For example, products that are nickel or chromium plated stand up better if the base metal is non-rusting, as is copper and brass. To take another example, look at vitreous-enameled emblems, used as trade-marks, name plates, medals, lapel pins, insignia, and so on. Most of these emblems have a copper alloy as the base metal; only that, or gold or silver, can be used.

These emblems owe their beautiful and permanent colors to silicate pastes and powders, inlaid by skilled artisans, and twice fused in a furnace at a temperature of about 1500° F. This temperature sets high standards for the underlying metal which must not warp, nor "bubble up" into the enamel. Thus visible beauty for which so much creative skill is required, depends in part on the invisible metal underneath. Revere, which takes great pains to maintain the strict standards of its alloys, is proud to meet the high requirements of American Emblem and other companies in this field . . . Perhaps Revere can help you by supplying exactly what you require to protect the finish and durability of your product.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.

Sales Offices in Principal Cities, Distributors Everywhere.

Polishing and Buffing Equipment

HAMMOND MACHINERY BUILDERS, INC., 1614 Douglas Ave., Kalamazoo, Mich. Bulletin 10, announcing a new line of ten "Junior Automatics" for use in conjunction with Hammond polishing and buffing lathes or similar machines. 10

Welding Accessories

AIR REDUCTION SALES CO., 60 E. 42nd St., New York 17, N. Y. Catalogue illustrating and describing the company's line of oxy-acetylene and electric arc welding accessories, including goggles, gloves, electrode-holders, cable, etc. 11

Aircraft Steels

JOSEPH T. RYERSON & SON, INC., Box 8000-A, Chicago 80, Ill. 64-page booklet describing Ryerson aircraft quality alloy and stainless steels and listing, in condensed form, aeronautical material specifications pertaining to steel. 12

Single-Spindle Automatic Turret Machine

CLEVELAND AUTOMATIC MACHINE CO., 4936 Beech St., Cincinnnati 12, Ohio. Bulletin AB, containing complete information on the new Cleveland Model AB "Dialmatic" single-spindle automatic turret machine. 13

Centralized Lubrication

FARVAL CORPORATION, 3293 E. 80th St., Cleveland 4, Ohio. Circular entitled "Studies in Centralized Lubrication," illustrating and describing applications of Farval centralized lubricating systems and the economies obtained by their use. 14

Stampings and Forgings

COMMERCIAL SHEARING AND STAMPING CO., Youngstown 1, Ohio. Circular describing the design, applications, and advantages of the stampings, forgings, hydraulic equipment, and assembled products made by this concern. 15

Air Motors and Compressors

GAST MFG. CORPORATION, Benton Harbor, Mich. Bulletin A-33, entitled "Application Ideas," describing twenty-six product design problems involving the application of rotary air motors, compressors, and vacuum pumps. 16

Cemented-Carbide Tools

UNION TWIST DRILL CO., Athol, Mass. Catalogue CA, containing dimensional and other data on the line of cemented-carbide turning and boring tools, drills, reamers, milling cutters, and other tools made by this company. 17

High-Speed Steels

JESSOP STEEL CO., Washington, Pa. Catalogue describing the analysis, heat-treatment, applications, and available forms of five different types of Jessop high-speed steels. Forging and grinding instructions are included. 18

Corrosion-Resisting Motors

RELIANCE ELECTRIC & ENGINEERING CO., 1077 Ivanhoe Road, Cleveland 10, Ohio. Bulletin C-130, describing the design features of the Reliance explosion-proof, corrosion-resisting alternating-current motor. 19

Metal-Cutting Tools for Aircraft Industry

NATIONAL TWIST DRILL & TOOL CO., Rochester, Mich. Supplement to catalogue 16, giving dimensions and list price of drills and reamers designed for use in the aircraft and light metal industries. 20

Sub-Contracting Facilities

WESTINGHOUSE ELECTRIC CORPORATION, 410 Bush St., San Francisco 8, Calif. Booklet B-4305, describing the sub-contracting facilities available to industry at the Sunnyvale, Calif., plant of the company. 21

Gear-Cutting and Milling Machines

WHITON MACHINE CO., New London, Conn. Bulletin G-1, descriptive of the Whiton automatic gear-cutting machine. Bulletin M-1, on Whiton special-purpose high-production machine. 22

Tangent Benders

STRUTHERS WELLS CORPORATION, Titusville, Pa. Catalogue T-1210, illustrating and describing the tangent benders made by this concern for any workable metal, hot or cold. Production data is included. 23

Pipe Tools

TOLEDO PIPE THREADING MACHINE CO., Toledo, Ohio. Catalogue containing 52 pages of data on the complete line of Toledo pipe tools, power pipe machines, power drives, and accessory equipment. 24

Mechanical and Hydraulic Presses

E. W. BLISS CO., 1420 Hastings St., Toledo 7, Ohio. Circular illustrating and describing a number of installations of Bliss mechanical and hydraulic presses applied to different types of work in a variety of industries. 25

Force Measuring Device

BALDWIN LOCOMOTIVE WORKS, Philadelphia 42, Pa. Bulletin 274, describing applications of the SR-4 "Load Beam," a sensitive and accurate device for general force measurement and process and machine control. 26

Resinoid-Bonded Diamond Wheels

MANHATTAN RUBBER DIVISION, RAYBESTOS - MANHATTAN, INC., Passaic, N. J. Catalogue describing the various types and sizes of resinoid-bonded diamond wheels made by this company. 27

Self-Dressing Grinding Wheels

MID-WEST ABRASIVE CO., 510 S. Washington St., Owosso, Mich. Circular entitled "Lower Grinding Costs through Mid-West Self-Dressing Centerless Grinding Wheels." 28

Universal Flame-Hardening Machine

STEARNS ROGER MFG. CO., Denver 2, Colo. Catalogue illustrating and describing the construction and application of the Denver electronic universal flame hardener. 29

Welding Rods and Fluxes

ALL-STATE WELDING ALLOYS CO., INC., 273 Ferris Ave., White Plains, N. Y. Handbook and catalogue listing the All-State welding rods and fluxes, including several new products. Full application information is given. 30

Grinding Wheel Speeds

GRINDING WHEEL INSTITUTE, Box 64, Greendale, Mass. Booklet entitled "Safe Speeds for Grinding Wheels," giving established rules governing safe operating speeds for grinding wheels. 31

Forging Hammers

C. C. Bradley & Son, Inc., Syracuse, N. Y. Booklet giving construction details on the four types of Bradley hammers, which cover a wide range of light- to medium-weight forging. 32

Saw and Knife Fitting Machinery

Samuel C. Rogers & Co., 191 Dutton Ave., Buffalo 11, N. Y. Illustrated price list, covering the Rogers line of knife grinders, saw sharpeners, and accessories. 33

Live Centers

Sturdimatic Tool Co., 5226 Third Ave., Detroit 2, Mich. Catalogue 449, containing specifications and prices covering the "engineered" live centers made by the company. 34

High-Speed Band Saws

Moak Machine & Tool Co., Port Huron, Mich. Bulletin describing Moak high-speed band saws for sawing sheet metal, alloys, wood, paper, etc. 35

Automatic Recessing Tools

Scully-Jones & Co., 1906 S. Rockwell St., Chicago 8, Ill. Manual of 25 pages on automatic recessing tools, giving their applications, operation, and construction features. 36

Magnesium Die-Castings

Doehler-Jarvis Corporation, 386 Fourth Ave., New York 16, N. Y. Circular entitled "Doehlerize to Economize," showing typical examples of "Doler-Mag" magnesium die castings. 37

Cutting Oil

Gulf Oil Corporation, Gulf Bldg., Pittsburgh, Pa. Circular outlining the properties of Gulf "Cutx B" cutting oil and its advantages for general-purpose machining. 38

Precision Valves

Hanna Engineering Works, 1765 Elston Ave., Chicago 22, Ill. Catalogue 251, covering the complete line of Hanna precision valves, including several new designs. 39

Diamond Wheel Dressing

J. K. Smit & Sons, Inc., Murray Hill, N. J. Pamphlet descriptive of the "DressOmeter," a newly designed automatic diamond dressing tool for grinding wheels. 40

Expansion Joints

Chicago Metal Hose Corporation, Maywood, Ill. Bulletin EJ - 49, containing engineering data on expansion joints for use where extreme pressures and temperatures are encountered. 41

Micrometers

Swedish Gage Co. of America, 8900 Alpine Ave., Detroit 4, Mich. Catalogue containing information, including prices, on the company's line of precision micrometers. 42

Electric Lift-Trucks

Barrett-Cravens Co., 4609 S. Western Blvd., Chicago 9, Ill. Bulletin 4861, describing the Barrett improved "Ox" line of electric lift-trucks. 43

Die Polishing Machine

Hartford Special Machinery Co., Hartford 5, Conn. Bulletin PM-100, containing specifications on a die polishing machine with an endless abrasive belt. 44

Universal Broach Sharpeners

Colonial Broach Co., Box 37, Harper Station, Detroit 13, Mich. Bulletin CS4-36, describing a new universal broach sharpener, for both round and flat broaches....45

Corrosion-Resistant Coatings

Dennis Chemical Co., 2701 Papin St., St. Louis 3, Mo. Folder entitled "Perma-Skin Vinyl Corrosion-Resistant Protective Coatings." 46

Zinc-Base Metals

American Nickeloid Co., Peru, Ill. Folder describing this company's line of zinc-base metals, furnished in sheets, coils, or flat strips. 47

Hard-Surfacing Guide

Lincoln Electric Co., Cleveland 1, Ohio. Circular describing procedures to follow in using Lincoln hard-surfacing electrodes...48

Chain Pipe Wrenches

Billings & Spencer Co., Hartford 1, Conn. Folder CP93, illustrating and describing Billings chain pipe wrenches. 49

Timing Motors

Haydon Mfg. Co., Inc., Torrington, Conn. Catalogue 321, covering the Haydon line of synchronous timing motors. 50

To Obtain Copies of New Trade Literature

listed in this section (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail within three months of the date of this issue (July, 1949) to MACHINERY, 148 Lafayette Street, New York 13, N Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

NAME.. POSITION OR TITLE....................................

[This service is for those in charge of shop and engineering work in manufacturing plants.]

FIRM..

BUSINESS ADDRESS...

CITY.. STATE..

Hiding between Sheets of Metal?

The National Desertion Bureau, Inc., which "renders service gratis to an indigent clientele," appealed to us to publish a man-wanted-for-wife-desertion advertisement "in an early issue of your valued publication." Perplexed by the new role MACHINERY had been asked to assume, we found the clue in the fact that the man wanted was by occupation a sheet-metal worker.

Jules Verne on a Jet Bike

A European subscriber, writing in his native tongue, asked us for complete information about American-made "jet-propelled motors applicable to bicycles." If correctly interpreted (and we consulted not only bilingual dictionaries but colleagues in the automotive field), a startling trend may be developing right under our unsuspecting nose. We can foresee that a Saturday afternoon bike sortie could resolve itself into a pretty terrifying experience, with parching gases issuing from the bicycle motor and the ever imminent danger of shooting off into space and becoming a satellite on wheels of another planet. Coming down to earth, however, we are gently suggesting to our correspondent that he might mean the ordinary motor occasionally attached to a bicycle which rolls the pedal-lazy cyclist along at a purely terrestial speed with no more noise than would be made by a pocketful of corn rattling around in a popper.

Another Country Heard From

An agricultural machinery firm, Eshet Eilon by name, located in Naharia, Israel, wrote to us: "Here in Israel we have found your magazine informative and helpful in our factories. We look forward to the future issues of MACHINERY that will continue to bring to us the creative genius of American machinery production."

Like Dish Night in the Movies

The announcement of a conference sponsored by a national society contains this statement: "The program has been planned so that every person will be able to take home at least one idea that can be put to use at once."

A Snapper Gives Out – with Information

Remember when we asked what a snapper was? Man who is one now writes and tells us: "Around the coal fields a snapper is the man on the hind end of a trip of cars, or the same thing as a brakeman on the railroad; snapping in the mines is the same as braking on the railroads."—A. T. LeSeur, Fairmont, W. Va.

Tools Can Take It

Received a communication from Wilted, Inc., manufacturer of machine tools. Lucky they don't grow orchids.

THE ENGINE THAT P & W BUILT
Here are the Pratt & Whitney Aircraft men that developed the tooling that made possible the production of sheet-metal components of jet engines to the close tolerances that we described in our article beginning on page 152 of this issue. (Left to Right) Joseph H. Lareau, production engineer, press work; Arthur A. Merry, chief tool engineer; Russell Johnston, production superintendent, sheet metal area; Robert M. Treat, production engineer, welding assemblies; and Paul Krumm, supervising production engineer, sheet metal area

News of the Industry

California

Fred T. Miller, general sales manager of Adel Precision Products Corporation, Burbank, Calif., has been appointed vice-president in charge of engineering and sales. R. A. Stumm, Jr., previously assistant to president, has been made vice-president in charge of manufacturing.

V. E. Lawford has been made sales representative in the northern California territory for the Buckeye Tools Corporation, Dayton, Ohio, manufacturer of air and high-frequency electric portable tools. Mr. Lawford's headquarters are at 656 Thirty-first St., Oakland 9, Calif.

R. Bruce McKenzie has been appointed sales engineer for the state of California by the Butterfield Division, Union Twist Drill Co., Derby Line, Vt., manufacturer of taps, dies, reamers, and other cutting tools. He will make his headquarters in Los Angeles, Calif.

Illinois

Mattison Machine Works, Rockford, Ill., announce that they have purchased the line of production grinding machines formerly made by the Hanchett Mfg. Co., of Big Rapids, Mich. The Hanchett machines acquired include surface grinders, face grinders, and disk grinders of various types. These machines will supplement the Mattison line of high-powered precision surface grinders, way grinders for dovetails and undercuts, and abrasive-belt grinding and polishing machines.

Whiting Corporation, Harvey, Ill., manufacturer of trambeam overhead crane and monorail systems, announces the appointment of the following distributors: George E. Miller Co., 24 Brighton Ave., Boston 34, Mass.; Grays Metal Works, Inc., 56th St. and Grays Ave., Philadelphia 43, Pa.; and James J. Burke Co., 405 Kearns Bldg., Salt Lake City 1, Utah.

John J. Littley has been appointed sales engineer for the line of hydraulic presses and power tools built by the Eddystone Division of the Baldwin Locomotive Works, Philadelphia, Pa. Mr. Littley will be connected with the Baldwin Chicago district office.

John H. Leslie, formerly vice-president in charge of research and engineering for the Signode Steel Strapping Co., Chicago, Ill., has been elected president of the company, succeeding his father, John W. Leslie, who has become chairman of the board.

Gilfry Ward has been appointed vice-president in charge of sales for the American Manganese Steel Division of the American Brake Shoe Co., New York City. Mr. Ward will be located at Chicago Heights, Ill.

Michigan

R. W. Steere, Jr., has been appointed assistant chief engineer of the Plymouth Motor Corporation, Detroit, Mich., replacing A. W. Ross, who has been transferred to an executive assignment with the corporation's Central Engineering Division.

Gisholt Machine Co., Madison, Wis., announces that its Detroit branch office has moved to new quarters at 15484 James Couzens Highway, Detroit 21, Mich.

Tinnerman Products, Inc., announces the removal of its Detroit district offices to larger quarters at 14550 Third Ave.

New England

Torrington Co., Torrington, Conn., manufacturer of ball and roller bearings, announces the appointment of the following distributors: Fischer Bearing Co., Chattanooga, Tenn.; Tennessee Bearings, Inc., Knoxville, Tenn.; Electric Service & Supply Co., Odessa, Tex.; W. P. Cunningham Co. and P. L. Walker Co., both of Houston, Tex.; and Binkleman Bearings, Inc., Toledo 1, Ohio.

P. W. Grace has been appointed assistant to the president of the Capewell Mfg. Co., Hartford, Conn., manufacturer of band- and hack-saw blades, machinists' hammers, drop-forgings, etc. John W. Clark has been made director of sales and executive assistant to the president.

Harry R. Reynolds has been appointed consulting engineer of the Fafnir Bearing Co., New Britain, Conn. Mr. Reynolds was formerly chief engineer, and the position he vacated will be filled by Howell L. Potter, who was previously assistant chief engineer.

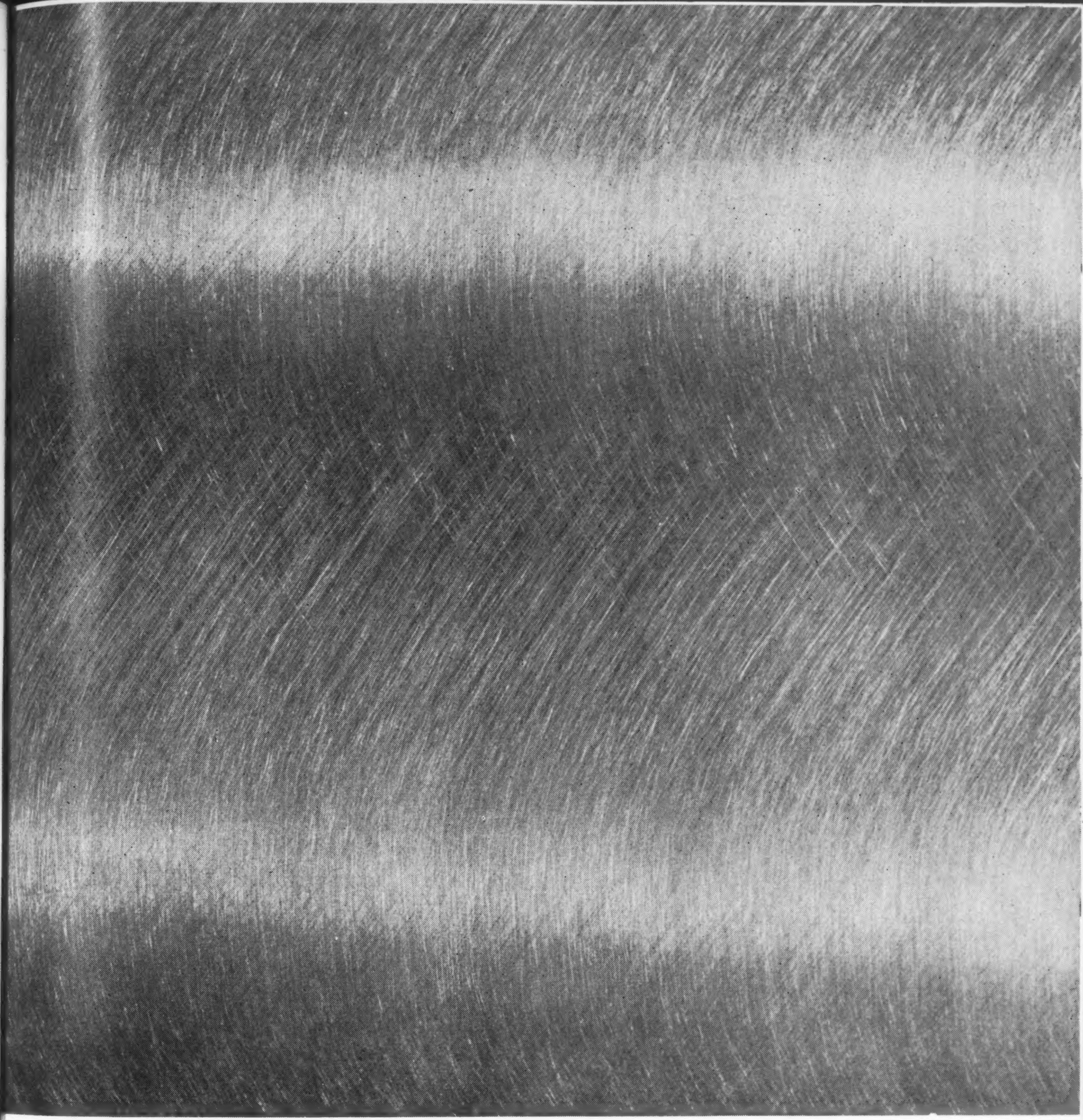
John W. Nickerson, 46 Mountain View Drive, Hartford, Conn., announces the availability of his services as consultant in management engineering.

W. L. Hubbard has been elected president of the Norma-Hoffmann Bearings Corporation, Stamford, Conn., succeeding C. P. Collins, who resigned.

Taft-Peirce Mfg. Co., Woonsocket, R. I., has appointed the G. C. Wood Co., Clark Bldg., Pittsburgh, Pa. and the A. J. Rod Co., 924 M & M Bldg., Houston, Tex., agents for Taft-Peirce gages and standard products.

J. B. Johnson, vice-president and general manager of the Bryant Chucking Grinder Co., Springfield, Vt., has resigned his position with the company, although he will continue as a director. Mr. Johnson has been associated with the Bryant organization for the last thirty-nine years, having been successively draftsman, designer, chief engineer, and since 1939, vice-president and general manager. Under his guidance, the company received five Army-Navy "E" awards during the war period. J. H. Beardsley, assistant to the president, will assume the position of general manager.

J. B. Johnson, who has resigned as vice-president and general manager of the Bryant Chucking Grinder Co.



© Fabian Bachrach

(Left) Clarence W. Daniels who is retiring as plants engineer of the Norton Co., after thirty-six years of service. (Right) Allan F. Hardy, Jr., new plants engineer

CLARENCE W. DANIELS, plants engineer and a director of the Norton Co., Worcester, Mass., retired recently after thirty-six years of service. He will continue to serve on the board of directors, to which he was first elected in 1925. ALLAN F. HARDY, JR., assistant plants engineer, has been promoted to the position of plants engineer.

F. W. MCINTYRE, SR., president of the Reed-Prentice Corporation, Worcester, Mass., manufacturer of machine tools, die-casting machines, and injection molding presses, has gone abroad on a business trip. During his five weeks' stay in Europe, Mr. McIntyre plans to visit England, France, and Italy, where he will observe many Reed-Prentice installations.

NORTON CO., Worcester, Mass., has recently established a new district office in St. Louis, Mo., with R. O. ANDERSON in charge as district manager. Mr. Anderson was formerly located at Denver, Colo. H. G. BRUSTLIN has been appointed abrasive engineer in charge of the Denver territory.

A. A. CAMBRIA has been appointed director of sales of the Progressive Tool & Die Co., 25 Foster St., Worcester, Mass. He was formerly district manager in New England for the U. S. Broach Co.

New Jersey

MANHATTAN RUBBER DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J., recently honored 600 employes who have been with the company twenty-five years or more at a dinner of the employes' association known as the "Pioneers." CHARLES KUHN, New York branch salesman, is the senior member, with fifty-five years of continuous service to his credit. Thirty-two new Pioneers were presented with pins set with diamonds that indicate the employe's length of service.

DR. ROY D. HALL, associated with the Lamp Division of the Westinghouse Electric Corporation at Bloomfield, N. J., for thirty-eight years, was recently awarded the annual medal of the Stevens Institute of Technology for outstanding achievement in the field of powder metallurgy. After the presentation, Dr. Hall gave the annual medal lecture, taking as his subject The Use of Trace Elements in Powder Metallurgy."

GEORGE A. BURGERMASTER and C. RUSSELL TODD have been appointed assistant purchasing agents for the Hyatt Bearings Division of General Motors Corporation, Harrison, N. J. WILLIAM E. JONES, assistant purchasing agent since 1925, has retired, and LEO V. FARRELL has been promoted from assistant purchasing agent to general purchasing agent, the position formerly held by FRANK A. WEISS, now assistant to the general manager, H. O. K. MEISTER.

M & N MACHINE TOOL WORKS, INC., have erected a new building at 287 Allwood Road, Clifton, N. J., which is expected to be ready for occupancy in the near future.

ARTHUR M. JORGENSEN has been appointed sales engineer for the Magnolia Metal Co., Elizabeth, N. J. He will cover the Wisconsin and Minnesota territory.

New York

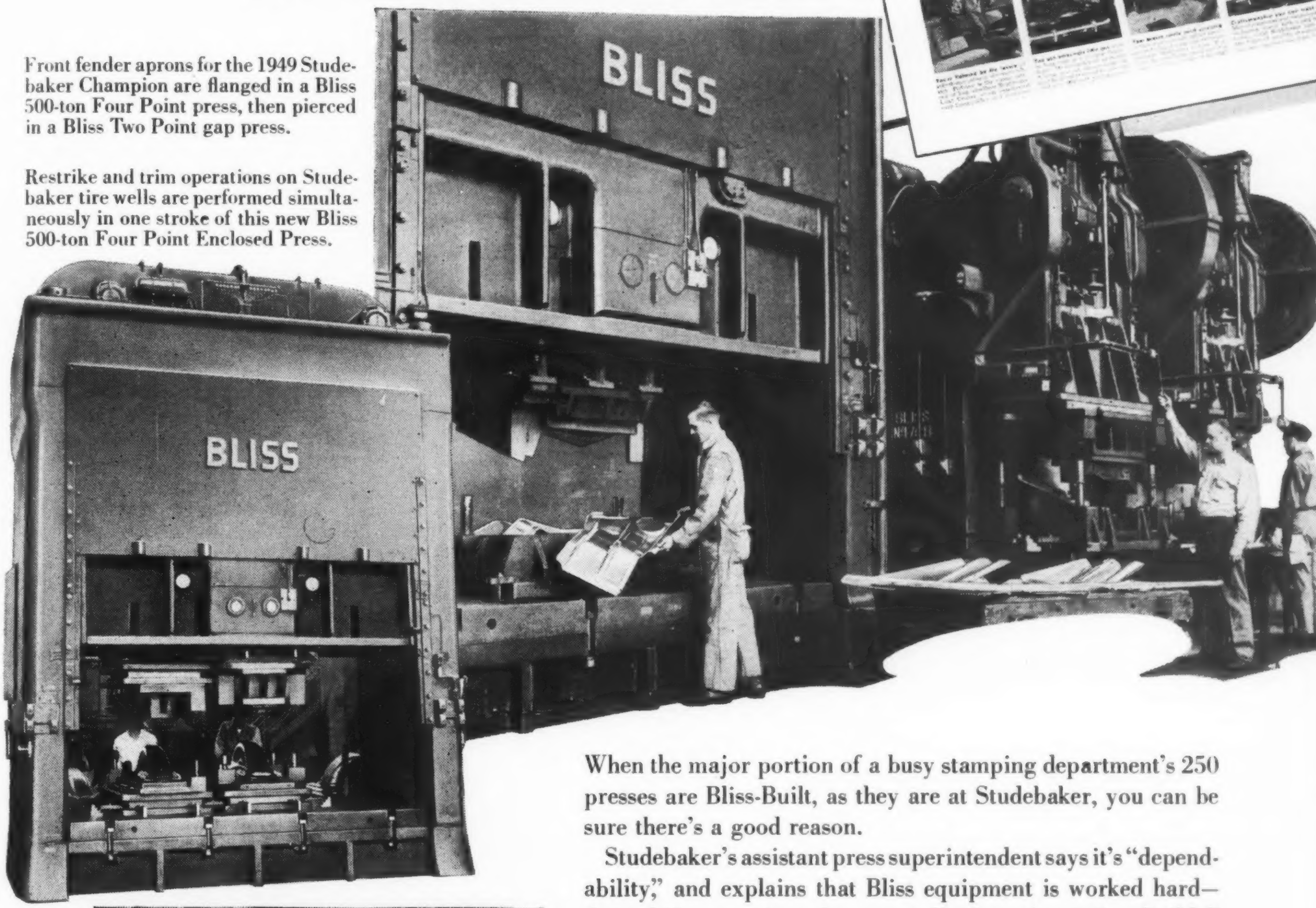
RUDEL MACHINERY CO., INC., 100 E. 42nd St., New York 17, N. Y., machine tool dealer, announces that the C. H. BRIGGS MACHINE TOOL CO., INC., of Syracuse, N. Y., has been merged with its organization, and will be known in the future as the C. H. BRIGGS DIVISION OF THE RUDEL MACHINERY CO., INC. The newly organized company has purchased the physical assets of the GEORGE KELLER MACHINERY CO., of Buffalo and Rochester, and will represent machine tool manufacturers in western New York State. The Briggs organization will remain intact, C. H. BRIGGS becoming a vice-president and director of the Rudel Machinery Co. He will be in charge of the Briggs Division. Many of the firms formerly represented by the George Keller Machinery Co. will now be represented by the new division of the Rudel Machinery Co.

CURTIS C. GARY has been appointed assistant to the president of the Brake Shoe & Castings Division of the American Brake Shoe Co., 230 Park Ave., New York 17, N. Y. Since 1947, Mr. Gary has been assistant to the vice-president in charge of division sales. JOHN F. DUCEY, JR., and SAM R. WATKINS have been appointed district sales managers of the company. Mr. Ducey is located at the New York office, while Mr. Watkins is in the Cleveland, Ohio, sales office.

JOHN A. CARTER, formerly general manager of Oakite Products, Inc., 22 Thames St., New York 6, N. Y., manufacturer of industrial cleaning and allied materials, was elected president of the company at a recent meeting of the board of directors. D. C. BALL, founder and president for many years, was elected chairman of the board. Mr. Carter has

John A. Carter, recently elected president of Oakite Products, Inc.

...and BLISS is the press buy word at Studebaker



Front fender aprons for the 1949 Studebaker Champion are flanged in a Bliss 500-ton Four Point press, then pierced in a Bliss Two Point gap press.

Restrike and trim operations on Studebaker tire wells are performed simultaneously in one stroke of this new Bliss 500-ton Four Point Enclosed Press.

Double die set-up in another 500-ton Bliss press for restriking and trimming tire wells.

When the major portion of a busy stamping department's 250 presses are Bliss-Built, as they are at Studebaker, you can be sure there's a good reason.

Studebaker's assistant press superintendent says it's "dependability," and explains that Bliss equipment is worked hard—three shifts—year-in and year-out. Yet downtime is "negligible."

Such dependability begins with the prompt and practical on-the-scene assistance that Bliss engineers bring to the working-out of a pressed-metal problem—in matching the press to the job for maximum, low-cost production. And back of it is Bliss' 90-year fund of press-building knowledge, built into its complete line of mechanical and hydraulic presses.

That's why at Studebaker, as among so many major mass-producers, the buy word for presses is "BLISS."

You'll like talking over your pressed-metal problem with a Bliss Sales Engineer. Why not call him in now?

E. W. BLISS COMPANY, TOLEDO 7, OHIO

Mechanical and Hydraulic Presses, Rolling Mills, Container Machinery

MARQUETTE · BLISS · CONSOLIDATED · TOLEDO · BLISS BUILT

BLISS BUILDS MORE TYPES AND SIZES OF PRESSES THAN ANY OTHER COMPANY IN THE WORLD

been associated with the Oakite organization for thirty-four years. Also announced at the meeting was the election of DAVID S. BALL, former vice-president, to the newly created office of first vice-president.

AL-THERM, INC., 998 Bedford Ave., Brooklyn 5, N. Y., has recently been organized to represent manufacturers of industrial heating and other mechanical equipment in the territory of New York, New Jersey, and Connecticut. The staff consists of trained engineers with experience in this field.

WILLIAM D. POMEROY, for the last five years a sales engineer with the Snyder Tool & Engineering Co., Detroit, Mich., has been appointed sales representative for the company in New York, New Jersey, New England, and Pennsylvania. He will make his headquarters at 65 Cayuga St., Seneca Falls, N. Y.

WATCH-MOTOR MAINSPRING CO., INC., 145 Hudson St., New York City, manufacturer of watch springs and flat precision springs for industrial use, announces that the name of the company has been changed to SANDSTELL SPRING CO., INC.

LOUIS T. FRIEDMAN, formerly assistant professor of engineering at Champlain College, has been appointed head of the metallurgical engineering department of Sam Tour & Co., Inc., 44 Trinity Place, New York City.

Ohio

ELMES ENGINEERING DIVISION OF AMERICAN STEEL FOUNDRIES has recently moved from 230 N. Morgan St., Chicago, Ill., to larger quarters in Cincinnati, Ohio. All departments of the Division—operations, engineering, manufacturing, sales, and management—are now located at 1150 Tennessee Ave., Cincinnati 29. The Elmes organization, founded nearly a century ago, has occupied the plant in Chicago since 1892, but the growing demand for the company's hydraulic machinery products has necessitated more space. The new plant is equipped with the latest types of small, medium, and heavy machine tools for the manufacture of hydraulic presses, high-pressure pumps, hydraulic accumulators, and high-pressure control valves.

AUTOMATIC STEEL PRODUCTS, INC., Canton, Ohio, has announced the acquisition of the CLEVELAND TAPPING MACHINE CO., of Hartville, Ohio. W. R. HARRISON, president and general manager of the Cleveland Tapping Machine Co., will continue to direct its operations. A. M. WICKWIRE, president of Automatic Steel Products, will become a vice-president of the newly acquired firm, and CURTIS FRANKLIN, treasurer and secretary of Automatic Steel Products will hold the same position with the Cleveland company.

J. H. FERGUSON has been named district manager of the Akron, Ohio, branch office of the Bristol Co., Waterbury, Conn. Mr. Ferguson joined the Bristol sales organization in 1923, and since 1940 has been connected with the Washington, D. C., office. His headquarters will be at 727 Grant St., Akron 11, Ohio.

GEORGE S. CHIARAMONTE has been appointed assistant sales manager of the E. Horton & Son Co., Windsor Locks, Conn. He will have charge of the Cleveland and Pittsburgh areas, with headquarters at Cleveland, was connected previously with the Cushman Chuck Co.

J. G. SCHAEFER has been named manager of the Youngstown, Ohio, district office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. This office has recently been moved from the Mahoning Bank Bldg. to the Ohio Edison Bldg.

F. O. DUTTON has been appointed director of purchases for the E. W. Bliss Co., and will be located at the general offices, 1420 Hastings St., Toledo 7, Ohio.

FARREL-BIRMINGHAM CO., INC., Ansonia, Conn., has appointed C. A. LAPP & CO., Cleveland, Ohio, sales agent for Farrel gears and gear units.

Oregon and Washington

THERON HOWARD, head of tractor sales and service in the eastern division of the Hyster Co., Portland, Ore., has become manager of the company's Peoria, Ill., plant. J. F. LEWIS, formerly in charge of production and purchasing at the Peoria plant, has been transferred to Portland as chief production engineer.

EICHER & CO., 263 Coleman Bldg., Seattle 4, Wash., have taken over the engineering, sales, and servicing in the Seattle territory of the recording instruments made by the Esterline-Angus Co., of Indianapolis, Ind.

Pennsylvania

G. A. LORZ has been named superintendent of operations at the Mackintosh-Hemphill Co.'s Garrison plant in Pittsburgh, Pa., and will be succeeded in his former position as general foundry foreman by O. B. DOUTHETT. Announcement has also been made that C. R. HODGSON is now superintendent of operations at the Midland, Pa., plant. He was previously general foundry foreman at that plant, and is succeeded in the latter position by O. FEICHT. WALTER J. JOHNSON, formerly production manager at the Garrison plant, is now assistant plant manager.

HARRY A. FOHL has been named chief engineer of the Lukens Steel Co., Coatesville, Pa., and NEILS H. JENSEN assistant chief engineer. MALCOLM B. ANTRIM has been appointed superintendent of electrical maintenance. Mr. Fohl succeeds P. C. HALDEMAN, who has been chief engineer since 1932, and is now retiring. Mr. Antrim takes the place of WALTER H. BURR, superintendent of electrical maintenance since 1921.

SAMUEL WIT, sales engineer with the Lukenweld Division of the Lukens Steel Co., Coatesville, Pa., has been named district manager of sales of the Chicago office, succeeding J. H. FAUNCE, JR., who will assume other duties with the organization.

HAROLD J. ZILSKE has been appointed sales engineer in the Philadelphia area for the Parker Appliance Co., Cleveland, Ohio.

B. C. AMES CO., Waltham, Mass., manufacturer of precision micrometer dial indicators and gages, has appointed the G. C. WOOD CO., 814 Clark Bldg., 717 Liberty Ave., Pittsburgh, Pa., exclusive representative in the Tri-State area.

GEORGE V. LUERSSEN, chief metallurgist for the Carpenter Steel Co., Reading, Pa., was recently presented with the first annual David Ford McFarland Award by the Penn State Chapter of the American Society for Metals for eminence in the metallurgical profession.

George V. Luerssen, first recipient of David Ford McFarland Award for eminence in the metallurgical profession

You Win on Every Move!

Every product in this new catalog is KENNAMETAL, made to be a winner in productivity . . . in cost-saving

With Catalog 49 is a discount sheet announcing a 25% reduction in the price of standard brazed tools listed. Savings in production costs effected by improved manufacturing techniques enable us to give you this plus value.

Outstanding durability is inherent with Kennametal. Its structure is consistently sound, hardness is uniform, strength unusually high. All processing is done in our own plant, from the refining of raw materials to fabrication of complete tools. The methods and equipment used are original and exclusive. Every step is subjected to rigid laboratory control and physical inspection.

On metal-working tools the superior merits of Kennametal are manifest in longer life, reduced grinding expense, lower tool inventory, less machine down time, greater operator efficiency.

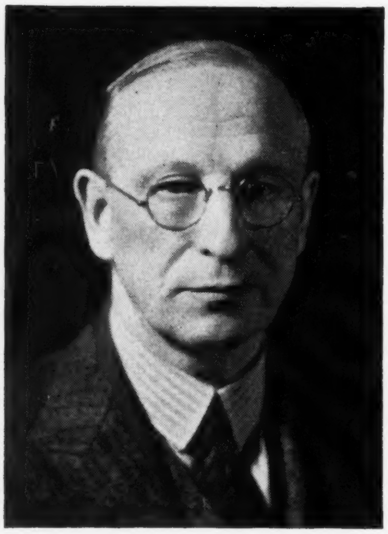
As parts of machines, particularly those subjected to wear, the noteworthy properties of Kennametal are evident in greater durability and better performance than ever realized with any other metal.

A new grade of Kennametal, developed to provide high resistance to oxidation at elevated temperatures, has many potential uses.

Our new Catalog 49 contains a wealth of information for metal-working plants. To secure your copy will be a good move. It suggests many subsequent moves that can be made to your advantage.

KENNAMETAL *Inc.*, Latrobe, Pa.

MANUFACTURERS OF SUPERIOR CEMENTED CARBIDES AND CUTTING TOOLS THAT INCREASE PRODUCTIVITY

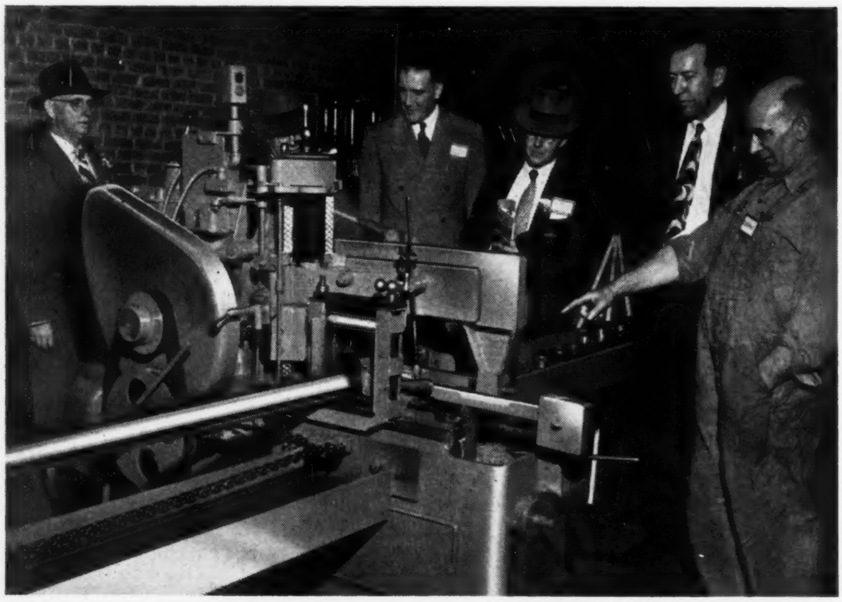



(Left) L. Gerald Firth, who has resigned as president of the Firth Sterling Steel and Carbide Corporation and (Right) J. W. Kinnear, Jr., who succeeds him

L. GERALD FIRTH, president and general manager of the Firth Sterling Steel & Carbide Corporation, McKeesport, Pa., since 1933, has resigned as president, and J. W. KINNEAR, JR., has been elected to succeed him. Mr. Kinnear has served as executive vice-president for nearly two years and has been a director for fifteen years. Mr. Firth will continue as a member of the board of directors and as director of research development. KENNETH D. MANN was elected chairman of the board at a special meeting of the directors. Until May 1 of this year, Mr. Mann had been manufacturing vice-president of the Reynolds Metals Co.

Joseph T. Ryerson & Son Celebrate Completion of Expansion Program

An open house in celebration of the completion of a new, larger plant and office building and greatly expanded plant facilities was held recently by Joseph T. Ryerson & Son, Inc., steel distributors, at 5200 Grays Ave., Philadelphia, Pa. Festivities extended over two days, about 2800 customers and friends of the firm visiting the plant on the first day and approximately 500 employes and their families on the second day. A tour of the plant, which covers 191,380 square feet of floor space, was planned to show visitors how a modern steel-service plant operates.



Visitors watching a machine operation while touring the recently enlarged and modernized steel-service plant of Joseph T. Ryerson & Son, Inc., in Philadelphia, Pa.

Coming Events

SEPTEMBER 21-24—Twenty-sixth annual convention of the NATIONAL ASSOCIATION OF FOREMEN at the Statler Hotel, Detroit, Mich. Headquarters of the Association, 321 W. First St., Dayton 2, Ohio.

SEPTEMBER 26-28—NATIONAL ELECTRONICS CONFERENCE at the Edgewater Beach Hotel in Chicago, Ill. Sponsored by the Illinois Institute of Technology, Chicago 16, Ill.

OCTOBER 10-14—National meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS in San Francisco, Calif.; headquarters, Fairmont Hotel. Headquarters of the Society, 1916 Race St., Philadelphia 3, Pa.

OCTOBER 17-21—NATIONAL METAL CONGRESS and EXPOSITION to be held in connection with the thirty-first annual meeting of the AMERICAN SOCIETY FOR METALS at the Public Auditorium in Cleveland, Ohio. National secretary, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 17-21—Fall meeting of the METALS BRANCH, AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, in Cleveland, Ohio. Secretary, E. H. Robie, 29 W. 39th St., New York 18, N. Y.

OCTOBER 17-21—Annual meeting of the AMERICAN SOCIETY FOR METALS in Cleveland, Ohio. Secretary, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 17-21—Annual meeting of the AMERICAN WELDING SOCIETY in Cleveland, Ohio. Executive secretary, Joseph G. Magrath, 33 W. 39th St., New York 18, N. Y.

OCTOBER 23-28 — Thirty-seventh NATIONAL SAFETY CONGRESS and EXPOSITION in Chicago, Ill. R. L. Forney, general secretary, National Safety Council, 201 N. Wacker Drive, Chicago 6.

SPECIFICATIONS FOR MAGNESIUM ALLOYS

Form of Magnesium Product	Composition, Per Cent (Remainder Magnesium): Aluminum	Zinc	Manganese	Dow Chemical Co. Alloy	American Magnesium Corp. Alloy	Army-Navy Aeronautical Specification	Navy Specification[1]	Army Specification	ASTM: Specification	ASTM: Alloy	ASM	SAE
Sheet	....	...	1.5	M	3S	AN-M-30	47M2	57-157	B90-46	M1	4370	51
	3.0	1.0	0.3	FS-1	C52S	AN-M-29	47M2	57-157	B90-46T	AZ31X	....	510
Extruded Bar, Rods, and Shapes	....	...	1.5	M	3S	AN-M-26	.....	AXS1328	B107-45T	M1	....	522
	3.0	1.0	0.3	FS-1	C52S	AN-M-27	.....	AXS1328	B107-45T	AZ31X	....	52
	6.5	1.0	0.2	J-1	C57S	AN-M-24	.....	AXS1328	B107-45T	AZ61X	4350	520
	8.5	0.5	0.2	O-1	C58S	AN-M-25	.....	AXS1328	B107-45T	AZ80X	....	523
Tubing	....	...	1.5	M	3S	AN-T-73	44T35	57-193	B217-46T	M1	....	522
	3.0	1.0	0.3	FS-1	C52S	AN-T-72	.....	57-193	B217-46T	AZ31X	....	52
	6.5	1.0	0.2	J-1	C57S	AN-T-71	44T35	....	B217-46T	AZ61X	....	520
Forgings	....	...	1.5	M	3S	AN-M-22	46M13	....	....	....	....	533
	3.0	1.0	0.3	FS-1	C52S	AN-M-20	......	....	B91-45T	AZ31X	....	...
	6.5	1.0	0.2	J-1	C57S	AN-M-21	46M13	....	B91-45T	AZ61X	....	531
	8.5	0.5	0.2	O-1	C58S	AN-M-23	46M13	....	B91-45T	AZ80X	4360	532
	3.5	(5.0 Tin)	0.5	D	65S	AN-M-23	46M13	....	B91-45T	AT35	....	53
Sand Castings	8.0	...	0.2	A	241	....	......	....	B80-45T	A8, A-8X	....	...
	12.0	...	0.2	B	246	....	......	....	B80-45T	A-12	....	...
	9.0	2.0	0.1	C	260	AN-M-36	......	....	B80-45T	AZ92, AZ92X	4430[4]	500
	10.0	...	0.1	G	240	....	......	....	B80-45T	A-10	....	...
	6.0	3.0	0.2	H	265	AN-M-36	......	57-74-1E	B80-45T	AZ63, AZ63X	4420[5]	50
	....	...	1.3	M	403	AN-M-36	......	....	B80-45T	M1	....	...
Permanent Molds	9.0	2.0	0.1	C	260	11349[2]	......	57-74-2	B199-45T	AZ92	4484	503
	10.0	...	0.1	G	240	11348[2]	......	....	B199-45T	A10, A-10X	....	...
Die-Castings	9.0	0.2	0.6	R	263	AN-M-16	......	57-74-3	B94-44T	AZ90	4490	501
Welding Rod	....	...	1.5	M	3S	11322[3]	......	....	....	....	....	...
	9.0	2.0	0.1	C	260	11322	......	....	....	....	....	...
	6.5	1.0	0.2	J-1	C57S	11322	......	....	....	....	....	...

Note: Letter or numerical suffixes designating revisions are omitted, since the latest revision in effect should always be used. [1]Applies to Bureaus of Navy other than Aeronautics. For Bureau of Aeronautics, Army-Navy Aeronautical specifications apply. [2]Army Air Forces specifications. [3]Ordnance Department. [4]ASM-4434 heat-treated and aged. [5]ASM-4420 as cast, AMS-4422 heat-treated, AMS-4424 heat-treated and aged.

MACHINERY'S Data Sheet No. 637, July, 1949 — Compiled by Brooks & Perkins, Inc.

SPECIFICATIONS FOR ALUMINUM ALLOYS*

Aluminum Alloy	Product	Federal	Army and Army Air Forces	Navy	Army-Navy (AN) Aeronautical	SAE: Handbook	SAE: AMS	ASTM
2S	Plate and Sheet	QQ-A-561	....	47A2e	....	25	4001A, 4003A	B25-44T, B178-44T
	Rivets	....	....	....	AN-R-19-2	25	7220A	....
	Rivet Wire	....	....	....	AN-QQ-W-298-3	25	....	....
3S	Plate and Sheet	QQ-A-359a	....	47A4d	....	29	4006A, 4008A	B79-44T, B126-44T
	Rivets	....	....	43R5g	....	....	....	....
	Rivet Wire	....	....	43R5g	....	....	....	....
17S	Plate and Sheet	QQ-A-353a	....	....	....	....	4030C, 4032C	B78-44T
	Rivets	....	....	....	AN-R-19-2	26	....	....
	Rivet Wire	....	....	....	AN-QQ-W-298-3	26	....	....
Pureclad 17S	Plate and Sheet	QQ-A-361	....	....	....	....	....	....
24S	Plate and Sheet	QQ-A-355a	....	47A10e	AN-A-12-1	24	4035B, 4037B	....
	Rivets	....	....	....	AN-R-19-2	24	....	....
	Rivet Wire	....	....	....	AN-QQ-W-298-3	24	....	....
Pureclad 24S	Plate and Sheet	QQ-A-362	....	....	AN-A-13-2	240	4040B, 4041B, 4042B	....
52S	Plate and Sheet	QQ-A-318a	....	47A11c	....	201	4015B, 4016B, 4017B	B109-44T
75S	Plate and Sheet	....	....	....	AN-A-9a	......	....	....
Clad 75S	Plate and Sheet	....	AXS-1649	....	AN-A-10b	......	....	....
Hard Clad R301	Plate and Sheet	....	....	....	AN-A-22	......	....	....
R353	Plate and Sheet	QQ-A-334	....	....	....	......	....	....
	Rivets	....	....	43R5g	....	282	....	....
	Rivet Wire	....	....	43R5g	....	282	....	....
R361	Plate and Sheet	QQ-A-327	....	47A12b	....	281	4025A, 4026A, 4027A	....
99.7 Per Cent	Sheet	....	....	....	....	......	4000A	....

*Always use latest revision of any specification indicated by a higher amendment number or suffix letter.

MACHINERY'S Data Sheet No. 638, July, 1949 — Compiled by the Reynolds Metals Co.

EX-CELL-O CORPORATION DETROIT 32

Special Multiple Way-Type Precision Boring Machines • Special Multiple Precision Drilling Machines • Precision Boring, Turning, and Facing Machines and Fixtures • Precision Cylinder Boring Machines • Precision Thread Grinding Machines • Precision Lapping Machines • Precision Broach Sharpening Machines • Other Special Purpose Machines • Tool Grinders • Continental Cutting Tools • Broaches and Broach Fixtures • Counterbore Sets • Grinding Spindles • Hydraulic Power Units • Drill Jig Bushings • R. R. Pins and Bushings • Fuel Injection Equipment • Dairy Equipment • Aircraft and Miscellaneous Production Parts

XLO

49-6

Henry L. Lampman being presented with a gold watch by E. Blakeney Gleason, president and general manager of Gleason Works

Gleason Co. Honors Retiring Gear Sales Manager

Henry Leon Lampman, gear sales manager of the Gleason Works, Rochester, N. Y., was recently honored at a dinner given by the company at the Oak Hill Country Club in Rochester, upon his completion of almost forty years of service with the organization. The affair was attended by about 500 members of the Gleason Works, and thirty-nine employes who had previously retired were also honored guests. Mr. Lampman was presented on behalf of the company with a gold watch, chain, and knife, by E. Blakeney Gleason, president and general manager.

Mr. Lampman became connected with the Gleason Works on February 14, 1910, after completing courses at the Rochester Business Institute. He was associated primarily with the engineering and sales phases of the business, and became widely known in general industry for his wise counsel and thorough knowledge of the many difficult problems associated with the bevel gear field.

Leeds & Northrup Co. Celebrates Fiftieth Anniversary

The fiftieth anniversary of the founding of the Leeds & Northrup Co., Philadelphia, Pa., is being celebrated this year. It was in June, 1899, that Morris E. Leeds started a company to provide an American source of electrical measuring instruments then made only in Europe. In the fifty years that have elapsed, the company has become a source of supply for such equipment throughout the world, and has played important parts in the national defense in both world wars.

Instruments sensitive enough to respond to the heat of a star, as well as automatic controllers sturdy enough to operate steel mill equipment, make up the diversified line of Leeds & Northrup products. Between the extremes are measuring and controlling instruments and heat-treating furnaces for nearly all industrial and scientific activities.

From his first day in business, Morris Leeds emphasized to his associates the responsibility of producing instruments of outstanding quality, accuracy, and reliability. He realized, however, that these qualities could not be obtained without due regard to human values. He therefore became a close student of industrial relations.

The advanced social and business concepts of Mr. Leeds, as well as the rigid standards he held for his products, have brought many awards to the company and to Mr. Leeds personally. In 1920, Mr. Leeds was awarded the Edward Longstreth Medal by the Franklin Institute of Philadelphia for his invention of the Leeds mechanism, the first automatic balance type recorder generally accepted for industrial use. In 1934, he received the Forbes Magazine Award for his employer-employe plan, and in 1936, the Institute of Management presented him with the Gantt Medal "for distinguished achievement in industrial management as a service to the community."

In 1946, he received the A.S.M.E. Medal "for outstanding achievements in the invention and development of electrical and temperature recording instruments, and in the field of industrial relations," and in the present year, the American Institute of Electrical Engineers presented him with its highest award, the Edison Medal for scientific achievement. He also received this year the Scientific Apparatus Makers' Association award "for outstanding achievement in the scientific instrument industry."

The company was presented in 1947 with the first annual Industrial Relations Award by the Philadelphia Chamber of Commerce "for developing and maintaining during the nearly fifty years of its existence one of this country's best industrial relations programs."

The company now employs approximately 2000 men and women at its Philadelphia plant and its fourteen district offices throughout the country. The fiftieth-anniversary celebrations were started by a dinner given by the company on June 4 to 3500 employes and guests. C. S. Redding, president, gave a brief talk in which he referred to the vision and achievements of Morris Leeds, who is now chairman of the board. Following the presentation of a gold fifty years' service plaque to Mr. Leeds, he was given a bound testimonial expressing the esteem of the organization for its founder. The testimonial was presented jointly by Robert Craig, president of the Leeds & Northrup Cooperative Association, J. H. Swope, president of the Employes' Union, and Mr. Redding. An entertainment and dance followed the dinner.

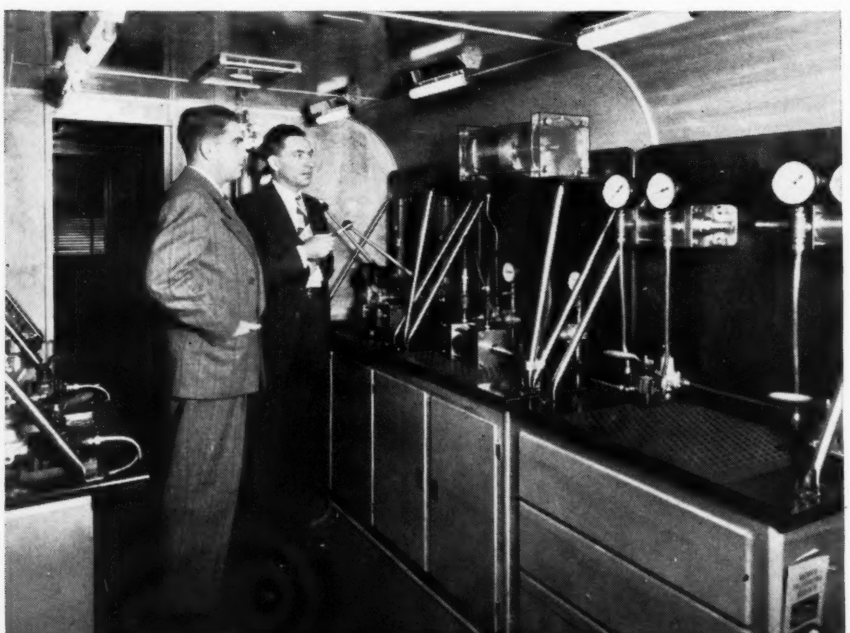
Morris E. Leeds, founder and chairman of the board of the Leeds & Northrup Co., being presented with a testimonial from his associates. (Left to Right) J. H. Swope, president of the Leeds & Northrup Employes' Union; Mr. Leeds; Robert Craig, president of Leeds & Northrup Cooperative Association; C. S. Redding, president of the company; and Mrs. Redding.

Visitors during the open house held at the L. S. Starrett Co. learning about the products of an automatic screw machine

L. S. Starrett Co. Holds Open House

More than one thousand men, women, and children toured the plant of the L. S. Starrett Co., Athol, Mass., during a recent three-day open house held during working hours. Thirty guides, selected for their general knowledge of plant operations, conducted small groups on individual tours. The guides were instructed to be sure that each visitor had an opportunity to chat with relatives or friends and to encourage each employe to explain personally to his guests the importance of his job and the purpose of the machines and tools being used.

Displays of precision tools, dial indicators, hacksaws, and band saws throughout the plant demonstrated how each employe's work contributes to the manufacture of an important product. The registration of visitors, serving of refreshments, and selecting and coaching of the guides were supervised by the personnel manager and his assistants.



Interior of the traveling exhibit used by the Miller Motor Co. to demonstrate the operation of air and hydraulic cylinders

Timken Celebrates Fiftieth Anniversary at Open House

The Timken Roller Bearing Co., Canton, Ohio, held an open house from June 20 to 24 in celebration of the fiftieth anniversary of the company. All of the other plants of the company—in Columbus, Zanesville, and Wooster, Ohio, in Colorado Springs, Colo., and in St. Thomas, Ontario, Canada—held open houses simultaneously. The guests were permitted to make a complete tour of the plants and observe all the manufacturing operations, including the making of tapered roller bearings and the steel mill processes.

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Foreign Sales of Welding Equipment Increase

Orders from foreign countries for resistance welding equipment received by member companies of the Resistance Welder Manufacturers Association reached the highest level of the year in April, according to B. L. Wise, president of the Association. The foreign orders in April were more than double those in March.

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"College of Cylinder Knowledge"

A unique direct approach to industrial merchandising is being made by the Miller Motor Co., Chicago, Ill., through the use of a traveling exhibit which is taken from plant to plant for the purpose of showing potential customers air and hydraulic cylinders of the company's manufacture in actual operation.

In this "College of Cylinder Knowledge," a standard air cylinder, in a transparent plastic container, is operated completely submerged in water; and a leakproof hydraulic cylinder designed for operation at 2000 pounds per square inch is operated at pressures up to 10,000 pounds per square inch to demonstrate the quality of construction. Other exhibits show the low-friction operation of these air and hydraulic cylinders. One air cylinder is operated at a line pressure of only 1 1/2 pounds per square inch, and one hydraulic cylinder at a line pressure of 2 1/2 pounds per square inch. Itineraries have been planned from coast to coast.